From: Robinson, Deborah
Required Attendees: Grandinetti, Cami; Stalcup, Dana; Ammon, Doug; Sheldrake, Sean; Koch, Kristine; Allen, Elizabeth; Christopher, Anne; parrett.kevin@deq.state.or.us; DECONCINI Nina; JOHNSON.Keith@deq.state.or.us; MCCLINCY.Matt@deq.state.or.us; gilles.bruce@deq.state.or.us; Fonseca, Silvina; Legare, Amy; Bill Ross (bross@rossstrategic.com); Conley, Alanna; Charters, David; Ells, Steve; Tom Roick (ROICK.Tom@deq.state.or.us); DeMaria, Eva; Zhen, Davis
Optional Attendees: Brave, Jennifer; Vilpas, Sirkku; Townsend, Tom; Fleming, Sheila; Poland, Melody; Cora, Lori
Location: Oregon Operations Office, Conference Line Personal Privacy / Ex. 6 0532#
Importance: Normal
Subject: Monthly EPA/DEQ Staff/Managers Meeting - Revised alternatives and screening of the alternatives
Start Date/Time: Wed 6/17/2015 8:00:00 PM
End Date/Time: Wed 6/17/2015 11:00:00 PM
2015 6 17 Draft Agenda EPA-DEQ Staff-Mgt as of 6-16-15 for review.docx
2015 6 17 Handout EPA-DEQ Staff-Mgt as of 6-16-15.docx

This invitation contains updated information about this meeting: Agenda updated 5:30 pm 6/16 and Handout.

For the month of June only, this meeting is rescheduled to the 3rd Wednesday.

Focus Topic:
Walk through EPA revised alternatives and screening of the alternatives.

1:00 - 3:00 - Includes staff people
3:00 - 4:00 - Managers only (this time was increased from ½ hour by agreement of the managers)

If information will be projected, here is the url for the adobe connect session:
Personal Privacy / Ex. 6

*Email records and attachments submitted via ECMS Extender may not have folders associated so may not show on this report. Record Center staff can provide separate listing for those documents.

HEADING: 0.0 TABLE OF CONTENTS/INDEX

HEADING: 1.0 SITE FILE REMEDIAL ADMINISTRATIVE RECORD

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 1/1/0111 Figure 5-14 Species Relabeling Check Sheet blank). .
DOCID: 713085
Pages: 1
Releasable
(Contains ELECTRONIC REC

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 5/1/1998 Portland Harbor Sediment Investigation Report.
DOCID: 712784
Pages: 48
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA Region 10

Date: 2/8/2001 Memorandum of Understanding for the Portland Harbor Superfund Site, signed by a total of 11 parties. Document is included in PORSF Section 10.1 by reference only. See folder 8.2 for actual document.
DOCID: 1128679
Pages: 26
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Confederated Tribes and Bands of the Yakima Inc
Unknown Unknown / Confederated Tribes of the Umatilla Indian Reser
Unknown Unknown / Confederated Tribes of the Grand Ronde Commu
Unknown Unknown / EPA
Unknown Unknown / Oregon Dept. of Environmental Quality

Date: 5/1/2001 Portland Harbor Fact Sheet.
DOCID: 1081737
Pages: 5
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 9/1/2001
DOCID: 1128576
Pages: 60
Releasable
(Contains ELECTRONIC REC

Administrative Order on Consent for Remedial Investigation/Feasibility Study. Total of 9 addressees.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / City of Portland, Oregon
Unknown Unknown / Port of Portland
Unknown Unknown / Northwest Natural Gas Co.
Unknown Unknown / Gunderson, Inc.
Unknown Unknown / Chevron USA, Incorporated

Date: 9/1/2001
DOCID: 1128882
Pages: 41
Releasable
(Contains ELECTRONIC REC

Statement of Work, Remedial Investigation/Feasibility Study (RI/FS) & Identification of Potential Early Action Areas for the Portland Harbor Superfund Site.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 10/23/2001
DOCID: 711559
Pages: 30
Releasable
(Contains ELECTRONIC REC

Administrative Order on Consent (AOC) for Remedial Investigation/Feasibility Study.

Authors:
Unknown Unknown / EPA

Date: 2/1/2002
DOCID: 711546
Pages: 24
Releasable
(Contains ELECTRONIC REC

Portland Harbor Community Involvement Plan.

Authors:
Unknown Unknown / DEQ
Unknown Unknown / EPA

Date: 2/1/2002
DOCID: 712785
Pages: 14
Releasable
(Contains ELECTRONIC REC

Draft Capping Material Evaluation Technical Memorandum.

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/1/2002
DOCID: 1128788
Pages: 6
Releasable
(Contains ELECTRONIC REC

Portland Harbor Fact Sheet, Launching the Investigation for Portland Harbor.

Authors:
Unknown Unknown / EPA
Unknown Unknown / Oregon Dept. of Environmental Quality

Addressee(s):
Unknown Unknown / Unknown

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 2/1/2002
DOCID: 1198773
Pages: 24
Releasable
(Contains ELECTRONIC REC

Portland Harbor Community Involvement Plan. (2nd AR Update)

Authors:
Unknown Unknown / Oregon Dept. of Environmental Quality
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 3/21/2002
DOCID: 1386183
Pages: 10
Releasable
(Contains ELECTRONIC REC

Letter of Agreement between the U.S. EPA, Region 10, the Oregon Department of Environmental Quality and the U.S. Army Corps of Engineers, Portland District concerning the Lower Williamette River (with attached Transmittal Letter).

Authors:
Kurt Burkholder / Oregon Dept. of Justice

Addressee(s):
Elizabeth McKenna / EPA

Date: 2/24/2003
DOCID: 713126
Pages: 1
Releasable
(Contains ELECTRONIC REC

R1 Field Sampling Report APPENDIX C (XLS) .

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 2/28/2003
DOCID: 713167
Pages: 9
Releasable
(Contains ELECTRONIC REC

SUMMARY OF ROUND 1/1A FIELD ACTIVITIES PORTLAND HARBOR RI/FS, with attached letter.

Authors:
Bob Wyatt / Lower Willamette Group
Mark Lewis / Lower Willamette Group
Unknown Unknown / Striplin Environmental Associates

Addressee(s):
Tara Martich / EPA
Chip Humphrey / EPA
Unknown Unknown / Lower Willamette Group

Date: 2/28/2003
DOCID: 713170
Pages: 0
Releasable
(Contains ELECTRONIC REC

SUMMARY OF ROUND 1/1A FIELD ACTIVITIES PORTLAND HARBOR RI/FS, with attached letter.

Authors:
Mark Lewis / Lower Willamette Group
Bob Wyatt / Lower Willamette Group
Unknown Unknown / Striplin Environmental Associates

Addressee(s):
Tara Martich / EPA
Unknown Unknown / Lower Willamette Group
Chip Humphrey / EPA

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 2/28/2003 Portland Harbor Cleanup Community Information Card.
DOCID: 713173
Pages: 2
Releasable
(Contains ELECTRONIC REC

Authors:
Chip Humphrey / EPA
Alanna Conley / EPA

Addressee(s):
Unknown Unknown / Public

Date: 3/14/2003 ROUND 1 FIELD SAMPLING REPORT PORTLAND HARBOR RI/FS.
DOCID: 712985
Pages: 44
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Striplin Environmental Associates
Unknown Unknown / Ellis Environmental Services
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Fishman Environmental Services, LLC
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 3/14/2003 R1 Field Sampling Report TABLES (XLS) .
DOCID: 713129
Pages: 1
Releasable
(Contains ELECTRONIC REC

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 3/14/2003 Figure 5-13 Lab Sample Storage Log Data Sheet (XLS).
DOCID: 713166
Pages: 1
Releasable
(Contains ELECTRONIC REC

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 3/14/2003 Draft Round 1 Field Sampling Report, Portland Harbor RI/FS. Total of 6 authors. Releasable per Kristine Koch. 6/3/2014
DOCID: 1160451
Pages: 233
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Fishman Environmental Services, LLC
Unknown Unknown / Striplin Environmental Associates
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 4/17/2003
DOCID: 712984
Pages: 31
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 2A QUALITY ASSURANCE PROJECT PLAN ADDENDUM DRAFT.

Authors:
Unknown Unknown / Striplin Environmental Associates

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/1/2003
DOCID: 712914
Pages: 45
Releasable
(Contains ELECTRONIC REC

SEDIMENT STAKE EROSION/ACCRETION MONITORING REPORT ROUND 1A PORTLAND HARBOR RI/FS.

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/30/2003
DOCID: 712912
Pages: 40
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS HISTORICAL CHEMISTRY DATA CATEGORY RECLASSIFICATION TECHNICAL MEMORANDUM.

Authors:
Unknown Unknown / Striplin Environmental Associates

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/30/2003
DOCID: 712913
Pages: 40
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS HISTORICAL CHEMISTRY DATA CATEGORY RECLASSIFICATION TECHNICAL MEMORANDUM.

Authors:
Unknown Unknown / Striplin Environmental Associates

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/2/2003
DOCID: 712911
Pages: 62
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Upland Groundwater Data Review Report River Mile 2 ? 11 Lower Willamette River.

Authors:
Unknown Unknown / Groundwater Solutions Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/16/2003
DOCID: 711560
Pages: 13
Releasable
(Contains ELECTRONIC REC

Amendment to AOC - Administrative Order on Consent (AOC) for Remedial Investigation/Feasibility Study, signed.

Authors:
Unknown Unknown / EPA

SUB-HEAD: **1.1 Vol. 1** **Reports**

Date: 6/16/2003
DOCID: 1175377
Pages: 13
Releasable
(Contains ELECTRONIC REC

Amendment No. 1: Administrative Order on Consent for Remedial Investigation/Feasibility Study, Docket Number CERCLA 10-2001-0240. Total of 11 respondents.

Authors:
Sylvia Kawabata / EPA
Thomas Sass / Gunderson, Inc.
Gordon Turl / Chevron USA, Incorporated
Unknown Unknown / ConocoPhillips Company
Unknown Unknown / ATOFINA Chemicals, Inc.

Addressee(s):
M. Kathleen Kelley / EPA

Date: 7/1/2003
DOCID: 1175035
Pages: 10
Releasable
(Contains ELECTRONIC REC

Fact Sheet: Summer 2003 Portland Harbor Project Newsletter.

Authors:
Unknown Unknown / EPA
Unknown Unknown / Oregon Dept. of Environmental Quality

Addressee(s):
Unknown Unknown / Unknown

Date: 10/22/2003
DOCID: 712910
Pages: 54
Releasable
(Contains ELECTRONIC REC

Round 1 Tissue Sample Collection and Archive Information Summary Tables.

Authors:
Robert Wyatt / Northwest Natural Gas Company
Jim McKenna / Port of Portland

Addressee(s):
Tara Martich / EPA
Chip Humphrey / EPA

Date: 12/1/2003
DOCID: 1185041
Pages: 6
Releasable
(Contains ELECTRONIC REC

Portland Harbor - Cleanup Newsletter.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 4/23/2004
DOCID: 712908
Pages: 217
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS PROGRAMMATIC WORK PLAN.

Authors:
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 4/23/2004 Portland Harbor RI/FS: Programmatic Work Plan - Volume One: Text, Figures and Tables.
DOCID: 1185725
Pages: 508
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Groundwater Solutions Inc.
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/23/2004 Portland Harbor RI/FS: Programmatic Work Plan - Volume Two: Appendices A - G.
DOCID: 1185726
Pages: 880
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Groundwater Solutions Inc.
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/23/2004 Portland Harbor RI/FS: Programmatic Work Plan - Map Folio.
DOCID: 1185727
Pages: 205
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Groundwater Solutions Inc.
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/2/2004 PORTLAND HARBOR RI/FS ROUND 2 FIELD SAMPLING PLAN SHOREBIRD AREA AND BEACH SEDIMENT SAMPLING.
DOCID: 712903
Pages: 20
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 6/21/2004
DOCID: 712904
Pages: 101
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 2 FIELD SAMPLING PLAN SEDIMENT SAMPLING AND BENTHIC TOXICITY TESTING.

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/21/2004
DOCID: 712906
Pages: 133
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 2 FIELD SAMPLING PLAN SEDIMENT SAMPLING AND BENTHIC TOXICITY TESTING.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/24/2004
DOCID: 712902
Pages: 162
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS ROUND 2 QUALITY ASSURANCE PROJECT PLAN.

Authors:
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/1/2004
DOCID: 712869
Pages: 13
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Deliverable Descriptions and Submittal Deadlines.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
unknown unknown / Unknown

Date: 7/6/2004
DOCID: 712909
Pages: 1
Releasable
(Contains ELECTRONIC REC

Round 1 Complete Set of Sampling Data.

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 10/1/2004
DOCID: 712855
Pages: 5
Releasable
(Contains ELECTRONIC REC

Portland Harbor Superfund Site Remedial Investigation/Feasibility Study Round 1 Site Characterization Summary Report Executive Summary.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
unknown unknown / Unknown

*Email records and attachments submitted via ECMS Extender may not have folders associated so may not show on this report.
Record Center staff can provide separate listing for those documents.

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 10/12/2004
DOCID: 712850
Pages: 51
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 1 SITE CHARACTERIZATION SUMMARY REPORT DRAFT.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/1/2005
DOCID: 712847
Pages: 58
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS DRAFT MONITORED NATURAL RECOVERY (MNR) TECHNICAL MEMORANDUM ? STEP 2 DATA EVALUATION METHODS.

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/22/2005
DOCID: 712799
Pages: 4
Releasable
(Contains ELECTRONIC REC

Letter to Early Action and Lower Willamette Group Project Managers Regarding Diving Safety, (less enclosure).

Authors:
Chip Humphrey / EPA
Sean Sheldrake / EPA
Eric Blischke / EPA

Addressee(s):
Robert Wyatt / NW Natural
Jim McKenna / Port of Portland
Anne Summers / Port of Portland
Larry Patterson / ARKEMA, Inc.

Date: 7/15/2005
DOCID: 712798
Pages: 44
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 2A SEDIMENT SITE CHARACTERIZATION SUMMARY REPORT DRAFT.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 11/4/2005
DOCID: 712642
Pages: 304
Releasable
(Contains ELECTRONIC REC

Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-102001-0240; LWG Food
Web Modeling Report: Evaluating TrophicTrace and the Arnot and Gobas Models for Application to the Portland Harbor Superfund Site.

Authors:
Robert Wyatt / NW Natural

Addressee(s):
Chip Humphrey / EPA

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 3/27/2006
DOCID: 712797
Pages: 72
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 3 JANUARY 2006 HIGH-FLOW SURFACE WATER FIELD SAMPLING REPORT DRAFT.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/26/2006
DOCID: 1225592
Pages: 13
Releasable
(Contains ELECTRONIC REC

Amendment No. 2: Administrative Order on Consent for Remedial Investigation/Feasibility Study, Docket Number CERCLA 10-2001-0240. With 6 additional authors.

Authors:
Sylvia Kawabata / EPA

Dan Saltzman / City of Portland, Oregon

Thomas Sass / Gunderson, Inc.

Gordon Turl / Chevron USA, Incorporated

Beth Ugoretz / Northwest Natural Gas Company

Addressee(s):
Unknown Unknown / EPA

Date: 6/12/2006
DOCID: 712641
Pages: 33
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS ROUND 2 MULTIPLATE INVERTEBRATE TISSUE DATA REPORT DRAFT.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 9/1/2006
DOCID: 1244235
Pages: 276
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Draft Round 2 Benthic Tissue and Sediment Data Report with included CD ROM.

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/7/2007
DOCID: 712640
Pages: 69
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS Round 3A FIELD SAMPLING PLAN STOR MWATER SAMPLING.

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 2/7/2007
DOCID: 712723
Pages: 69
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS Round 3A FIELD SAMPLING PLAN STORMWATER SAMPLING.

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259080
Pages: 732
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 2: Text, Figures, and Tables (Sections 9-15).

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259081
Pages: 693
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 1: Text, Figures, and Tables (Sections 1-8).

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259082
Pages: 375
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 3: Map Folio (1 of 2).

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 2/21/2007
DOCID: 1259083
Pages: 344
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 4: Map Folio (2 of 2).

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259084
Pages: 878
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 5: Appendices A, B, and C.

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259086
Pages: 537
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 6: Appendices D, E, and F.

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/21/2007
DOCID: 1259087
Pages: 952
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report, Volume 7: Appendices G, H, I, and J.

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: **1.1 Vol. 1** **Reports**

Date: 3/1/2007 Portland Harbor RI/FS Round 3A Field Sampling Plan Stormwater Sampling.
DOCID: 1259351
Pages: 150
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor Environmental, LLC
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 3/1/2007 Portland Harbor RI/FS Round 2 Quality Assurance Project Plan Addendum 8: Round 3A Stormwater Sampling.
DOCID: 1259352
Pages: 38
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/21/2007 Portland Harbor RI/FS, Round 3A Low-Flow and Stormwater Impacted Surface Water Data Report, Draft.
DOCID: 712223
Pages: 163
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/21/2007 Portland Harbor RI/FS, Round 3A Low-Flow and Stormwater Impacted Surface Water Data Report, Draft.
DOCID: 712224
Pages: 0
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/21/2007 PORTLAND HARBOR RI/FS COMPREHENSIVE ROUND 2 SITE CHARACTERIZATION SUMMARY AND DATA GAPS ANALYSIS REPORT.
DOCID: 715114
Pages: 1840
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Anchor Environmental, LLC

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 10/20/2007 Portland Harbor RI/FS, Draft Treatability Study and Literature Review.
DOCID: 712222
Pages: 12
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor Environmental, LLC

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 3/24/2008 Portland Harbor RI/FS, Sediment Chemical Mobility Testing Field Sampling Plan.
DOCID: 712221
Pages: 158
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor Environmental, LLC

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/1/2008 Portland Harbor RI/FS, Remedial Investigation/Feasibility Study Summary - Portland Harbor April 2008 Update Continued.
DOCID: 712220
Pages: 17
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / EPA Region 10

Addressee(s):
unknown unknown / Unknown

Date: 4/15/2008 Portland Harbor RI/FS, Superfund Site Overview.
DOCID: 712218
Pages: 41
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / EPA Region 10

Addressee(s):
unknown unknown / Unknown

Date: 4/15/2008 Portland Harbor RI/FS, Remedial Investigation/Feasibility Study Summary.
DOCID: 712219
Pages: 88
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / EPA Region 10
Eric Blischke / EPA

Addressee(s):
unknown unknown / Unknown

Date: 4/24/2008 Portland Harbor RI/FS, Round 3B Side Scan Sonar Field Sampling Plan.
DOCID: 712217
Pages: 26
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/7/2008 Portland Harbor RI/FS, Round 3 Lamprey Ammocoete Phase 2 Toxicity Testing Data Report.
DOCID: 712216
Pages: 33
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/16/2008 Portland Harbor RI/FS, Stormwater Loading Calculation Methods.
DOCID: 712213
Pages: 0
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 6/13/2008 Portland Harbor RI/FS, Round 3B Upland Stormwater Field Sampling Report.
DOCID: 712207
Pages: 561
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/13/2008 Portland Harbor RI/FS, Draft Final Sediment Chemical Mobility Testing Field Sampling Plan.
DOCID: 712212
Pages: 8
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor Environmental, L. L. C.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/2/2008 Portland Harbor RI/FS, Background Document: Application of Oregon Water Quality Standards, Draft.
DOCID: 712193
Pages: 54
Releasable
(Contains ELECTRONIC REC

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 7/3/2008 Portland Harbor RI/FS Background Data Processing and Outlier Identification.
DOCID: 711831
Pages: 35
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 8/1/2008 Portland Harbor RI/FS Draft Round 3B Sediment Data Report.
DOCID: 711830
Pages: 18
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 8/4/2008 Portland Harbor RI/FS Draft Round 2 Quality Assurance Project Plan Addendum 11: Sediment Chemical Mobility Testing.
DOCID: 711829
Pages: 26
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Unknown Unknown / Lower Willamette Group

*Email records and attachments submitted via ECMS Extender may not have folders associated so may not show on this report.
Record Center staff can provide separate listing for those documents.

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 9/30/2008 Portland Harbor RI/FS Round 3A and 3B Stormwater Data Report.
DOCID: 711828
Pages: 10
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / Anchor QEA, LLC
Unknown Unknown / Integral Consulting, Inc.
Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 2/1/2009 Community Involvement Plan, Newsletter.
DOCID: 711235
Pages: 24
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / EPA

Date: 2/11/2009 Human Health Risk Assessment Overview, (Community Advisory Group Meeting).
DOCID: 711234
Pages: 2
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / EPA

Date: 3/27/2009 Portland Harbor RI/FS Early Preliminary Remediation Goals Draft (PRGs).
DOCID: 711827
Pages: 86
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / Anchor QEA, LLC
Addressee(s):
Unknown Unknown / EPA

Date: 4/3/2009 Portland Harbor RI/FS Treatment beneficial Use Market Survey Draft.
DOCID: 711826
Pages: 118
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / Anchor QEA, LLC
Addressee(s):
Unknown Unknown / EPA

Date: 5/15/2009 Portland Harbor RI/FS Lower Willamete River Sidescan Sonar Data Report.
DOCID: 711825
Pages: 198
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / Anchor QEA, LLC
Addressee(s):
Unknown Unknown / EPA

Date: 6/5/2009 Pre-Feasibility Study Treatment Technologies Table Draft.
DOCID: 711817
Pages: 7
Releasable
(Contains ELECTRONIC REC
Authors:
Unknown Unknown / Lower Willamette Group
Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 6/19/2009
DOCID: 711816
Pages: 15
Releasable
(Contains ELECTRONIC REC

Screening of Disposal Facilities for the Feasibility Study.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Unknown Unknown / EPA

Date: 6/23/2009
DOCID: 711814
Pages: 2
Releasable
(Contains ELECTRONIC REC

Letter regarding Portland Harbor Site; Administrative Order on Consent for Remedial Investigation and Feasibility Study - Areas of Potential Concern.

Authors:
Chip Humphrey / EPA
Eric Blischke / Oregon Dept. of Environmental Quality

Addressee(s):
Robert Wyatt / Northwest Natural Gas Company

Date: 6/23/2009
DOCID: 711815
Pages: 4
Releasable
(Contains ELECTRONIC REC

Lines of Evidence Maps Referenced in June 23, 2009 AOPC Letter - Areas of Potential Concern.

Authors:
Chip Humphrey / EPA
Eric Blischke / Oregon Dept. of Environmental Quality

Addressee(s):
Robert Wyatt / Northwest Natural Gas Company

Date: 7/1/2009
DOCID: 711232
Pages: 3
Releasable
(Contains ELECTRONIC REC

Portland Harbor Superfund Site Update Information for Lower Columbia Basin PCB Workshop.

Authors:
Unknown Unknown / EPA

Date: 8/7/2009
DOCID: 711813
Pages: 5
Releasable
(Contains ELECTRONIC REC

Portland Harbor Site Remedial Action Objectives.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Portland Harbor Site File

Date: 8/19/2009
DOCID: 711812
Pages: 594
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Remedial Investigation Report - Appendix F Baseline Ecological Risk Assessment Draft.

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 9/23/2009
DOCID: 711811
Pages: 5612
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Remedial Investigation Report - Appendix F Baseline Human Health Risk Assessment Draft.

Authors:
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 10/1/2009
DOCID: 1309729
Pages: 30
Releasable
(Contains ELECTRONIC REC

Lower Willamette Group - Executive Summary - Portland Harbor Superfund Site Draft Remedial Investigation Report.

Authors:
Unknown Unknown / Unknown

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 10/27/2009
DOCID: 711810
Pages: 598
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Remedial Investigation Report Draft.

Authors:
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/2/2011
DOCID: 711127
Pages: 203
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Draft Final Remedial Investigation Report Apendix F Baseline Human Health Risk Assessment.

Authors:
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 5/2/2011
DOCID: 719431
Pages: 5308
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS DRAFT FINAL REMEDIAL INVESTIGATION REPORT APPENDIX F BASELINE HUMAN HEALTH RISK ASSESSMENT DRAFT FINAL.

Authors:
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/1/2011
DOCID: 711121
Pages: 746
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Appendix G Baseline Ecological Risk Assessmnet Draft Final.

Authors:
Unknown Unknown / The Lower Wilamette Group

Addressee(s):
Unknown Unknown / Windward Environmental, LLC.

ED_000959_Converted_PSTs_0009429 01/24/2020 SEMS_0333898
1-00019

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 8/29/2011 Draft Final Remedial Investigation Report Files, August 29, 2011.
DOCID: 654051
Pages: 0
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Integral Consulting, Inc.

Addressee(s):
Chip Humphrey / EPA
Kristine Koch / EPA
Audie Huber / Confederated Tribes of the Umatilla India
Jennifer Peers / Stratus Consulting, Inc.
Richard Kepler / Oregon Dept. of Fish and Wildlife

Date: 8/29/2011 Draft Portland Harbor Remedial Investigation Report Draft Final.
DOCID: 715320
Pages: 1649
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor QEA, LLC
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 12/6/2011 Baseline Human Health Risk Assessment (BHHRA) Dispute Decision.
DOCID: 715198
Pages: 10
Releasable
(Contains ELECTRONIC REC

Authors:
Daniel Opalski / EPA

Addressee(s):
Unknown Unknown / File

Date: 12/18/2011 EPA Comments on the March 2012 Draft Study Feasibility Study.
DOCID: 715196
Pages: 24
Releasable
(Contains ELECTRONIC REC

Authors:
Kristine Koch / EPA
Chip Humphrey / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 3/30/2012 Portland Harbor RI/FS Draft Feasibility Study.
DOCID: 706171
Pages: 1
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor QEA, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 3/30/2012 Portland Harbor RI/FS Draft Feasibility Study - Appendix.
DOCID: 706175
Pages: 1
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Anchor QEA, LLC
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 3/30/2012 Portland Harbor RI/FS Draft Feasibility Study, Draft.
DOCID: 711131
Pages: 950
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Anchor QEA, LLC
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 3/30/2012 Portland Harbor RI/FS Draft Portland Harbor Feasibility Study.
DOCID: 715311
Pages: 950
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Anchor QEA, LLC

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 4/1/2012 Feasibility Study and Sitewide Update Information.
DOCID: 711230
Pages: 4
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / EPA

Date: 5/1/2012 DRAFT ENGINEERING EVALUATION/COST ESTIMATE GASCO SEDIMENTS CLEANUP SITE.
DOCID: 719258
Pages: 2355
Releasable
(Contains ELECTRONIC REC

Authors:
Unknown Unknown / NW Natural
Unknown Unknown / Anchor QEA, LLC

Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 6/22/2012
DOCID: 711128
Pages: 4
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Draft Baseline Human Health Risk Assessment BHHRA Comment Letter.

Authors:
Chip Humphrey / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 6/22/2012
DOCID: 711130
Pages: 950
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Draft Feasibility Study, Draft.

Authors:
Unknown Unknown / Windward Environmental, LLC.
Unknown Unknown / Kennedy/Jenks Consultants
Unknown Unknown / Integral Consulting, Inc.
Unknown Unknown / Anchor QEA, LLC

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 6/22/2012
DOCID: 715200
Pages: 4
Releasable
(Contains ELECTRONIC REC

EPA's comments on the Lower Willamette Group's May 2, 2011 Draft Baseline Human Health Risk Assessment.

Authors:
Chip Humphrey / EPA
Kristine Koch / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 10/25/2012
DOCID: 711126
Pages: 2
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Baseline Human Health Risk Assessment BHHRA Dispute Partial Resolution.

Authors:
Daniel Opalski / EPA

Addressee(s):
Unknown Unknown / File

Date: 10/25/2012
DOCID: 715199
Pages: 2
Releasable
(Contains ELECTRONIC REC

Baseline Human Health Risk Assessment Dispute Decision Memo - Partial Resolution.

Authors:
Daniel Opalski / EPA

Addressee(s):
Unknown Unknown / File

Date: 12/7/2012
DOCID: 711125
Pages: 10
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Baseline Human Health Risk Assessment BHHRA Dispute Final Resolution.

Authors:
Daniel Opalski / EPA

Addressee(s):
Unknown Unknown / File

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 12/21/2012
DOCID: 711132
Pages: 44
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS EPA Supplemental Comments on the Portland Harbor RI/FS Draft Baseline Ecological Risk Assessment.

Authors:
Chip Humphrey / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 12/21/2012
DOCID: 715195
Pages: 44
Releasable
(Contains ELECTRONIC REC

EPA comments on the RI/FS Draft Baseline Ecological Risk Assessment.

Authors:
Chip Humphrey / EPA
Kristine Koch / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 1/14/2013
DOCID: 711227
Pages: 19
Releasable
(Contains ELECTRONIC REC

Proposed Confined Disposal Facility Questions and Answers.

Authors:
Unknown Unknown / EPA

Date: 1/14/2013
DOCID: 713375
Pages: 20
Releasable
(Contains ELECTRONIC REC

Confined Disposal Facility (CDF) Frequently Asked Questions.

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 1/14/2013
DOCID: 713377
Pages: 0
Releasable
(Contains ELECTRONIC REC

Confined Disposal Facility (CDF) Frequently Asked Questions.

Authors:
unknown unknown / Unknown

Addressee(s):
unknown unknown / Unknown

Date: 3/28/2013
DOCID: 687176
Pages: 3206
Releasable
(Contains ELECTRONIC REC

Final RI full Report regarding Appendix F: Baseline Human Health Risk Assessment.

Authors:
Unknown Unknown / Kennedy/Jenks/Chilton

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.1 Vol. 1 Reports

Date: 3/28/2013
DOCID: 713364
Pages: 141
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS FINAL REMEDIAL INVESTIGATION REPORT APPENDIX F BASELINE HUMAN HEALTH RISK ASSESSMENT FINAL March 28, 2013.

Authors:
Unknown Unknown / Kennedy/Jenks Consultants

Addressee(s):
Unknown Unknown / Lower Willamette Group
Unknown Unknown / EPA

Date: 4/10/2013
DOCID: 715194
Pages: 3
Releasable
(Contains ELECTRONIC REC

Notice of Assessment and Stipulated Penalties Letter to Lower Willamette Group.

Authors:
Lori Cohen / EPA

Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 8/1/2013
DOCID: 713363
Pages: 4
Releasable
(Contains ELECTRONIC REC

Portland Harbor RI/FS Human Health Risk Assessment Summary.

Authors:
Chip Humphrey / EPA
Alanna Conley / EPA
Kristine Koch / EPA
Elizabeth Allen / EPA

Addressee(s):
Unknown Unknown / Public

Date: 12/16/2013
DOCID: 713176
Pages: 62
Releasable
(Contains ELECTRONIC REC

PORTLAND HARBOR RI/FS FINAL REMEDIAL INVESTIGATION REPORT APPENDIX G BASELINE ECOLOGICAL RISK ASSESSMENT FINAL.

Authors:
Chip Humphrey / EPA
Alanna Conley / EPA

Addressee(s):
Unknown Unknown / EPA
Unknown Unknown / Lower Willamette Group

Date: 12/16/2013
DOCID: 1432515
Pages: 870
Releasable
(Contains ELECTRONIC REC

Final Remedial Investigation Report Appendix G Baseline Ecological Risk Assessment Final. Final, Volume I.

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / EPA Region 8
Unknown Unknown / Lower Willamette Group

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SUB-HEAD: 1.1 Vol. 1 Reports

Date: 12/16/2013
DOCID: 1432516
Pages: 1096
Releasable
(Contains ELECTRONIC REC

Final Remedial Investigation Report Appendix G Baseline Ecological Risk Assessment Final. Final, Volume II Attachments.

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / Lower Willamette Group
Unknown Unknown / EPA Region 8

Date: 12/16/2013
DOCID: 1432519
Pages: 53
Releasable
(Contains ELECTRONIC REC

Final Remedial Investigation Report Appendix G Baseline Ecological Risk Assessment Final. Final, Volume II Attachments.

Authors:
Unknown Unknown / Windward Environmental, LLC.

Addressee(s):
Unknown Unknown / EPA Region 8
Unknown Unknown / Lower Willamette Group

Date: 11/7/2014
DOCID: 715192
Pages: 75
Releasable
(Contains ELECTRONIC REC

Proposed Consent Decree between United States and Linnton Plywood Association to recover costs at the Portland Harbor Superfund Site.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Public

(Contains ELECTRONIC REC

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 1/1/1977
DOCID: 1094768
Pages: 31
Releasable

Synoptic survey of trace metals in bottom sediments of the Willamette River (reference 9).

Authors:
Unknown Unknown / U. S. Geological Survey

Addressee(s):
Unknown Unknown / Unknown

Date: 1/1/1990
DOCID: 1094761
Pages: 2
Releasable

Map of Linnton Quadrangle Oregon 7.5 Minute Series (topographic)(reference 3). Oversize document.

Authors:
Unknown Unknown / U. S. Geological Survey

Addressee(s):
Unknown Unknown / Unknown

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 1/1/1990
DOCID: 1094762
Pages: 2
Releasable

Map of Portland Quadrangle Oregon-Washington 7.5 Minute Series (topographic)(reference 3). Oversize document

Authors:
Unknown Unknown / U. S. Geological Survey

Addressee(s):
Unknown Unknown / Unknown

Date: 7/1/1994
DOCID: 1094772
Pages: 178
Releasable

Willamette River Toxics Study (reference 13).

Authors:
Unknown Unknown / Oregon Dept. of Environmental Quality

Addressee(s):
Unknown Unknown / Unknown

Date: 8/11/1995
DOCID: 1094769
Pages: 23
Releasable

Willamette River Basin Water Quality Study (reference 10).

Authors:
Unknown Unknown / Tetra Tech, Inc.

Addressee(s):
Unknown Unknown / Oregon Dept. of Environmental Q

Date: 11/1/1996
DOCID: 1094778
Pages: 19
Releasable

EPA Memorandum: Using qualified data to document an observed release and observed contamination (reference 19).

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 6/4/1997
DOCID: 1094771
Pages: 162
Releasable

Executive summary of historical sediment data and site investigation (reference 12).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 7/22/1997
DOCID: 1094776
Pages: 371
Releasable

Analytical data packages for Willamette River sampling event as part of the Columbia River channel deepening (reference 17).

Authors:
Unknown Unknown / U. S. Army Corps of Engineers

Addressee(s):
Unknown Unknown / Unknown

Date: 7/30/1997
DOCID: 1094767
Pages: 58
Releasable

Willamette River sampling and analysis plan (reference 8).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 9/16/1997
DOCID: 1094764
Pages: 8
Releasable

Sediment investigation field sampling logbook (reference 5).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / Unknown

Date: 9/16/1997
DOCID: 1094765
Pages: 713
Releasable

Portland Harbor sediment investigation data quality assurance packages (reference 6, part 1 of 3).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 9/16/1997
DOCID: 1094892
Pages: 643
Releasable

Portland Harbor sediment investigation data quality assurance package (reference 6, part 2 of 3).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 9/16/1997
DOCID: 1094893
Pages: 297
Releasable

Portland Harbor sediment investigation data quality assurance package (reference 6, part 3 of 3).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 9/17/1997
DOCID: 1094766
Pages: 104
Releasable

Portland Harbor sediment investigation chain-of-custody forms (reference 7).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 1/15/1998
DOCID: 1094775
Pages: 55
Releasable

Report of Environmental Roundtable regarding Columbia River channel deepening sediment quality evaluation (reference 16).

Authors:
Unknown Unknown / U. S. Army Corps of Engineers

Addressee(s):
Unknown Unknown / Unknown

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 5/13/1998
DOCID: 1094763
Pages: 676
Releasable

Sediment Investigation Report (reference 4).

Authors:
Unknown Unknown / Roy F. Weston, Inc.

Addressee(s):
Unknown Unknown / EPA

Date: 12/1/1998
DOCID: 1094773
Pages: 8
Releasable

Willamette River Spring Chinook Salmon Run for 1997 (excerpt)(reference 14).

Authors:
Unknown Unknown / Oregon Dept. of Fish and Wildlife

Addressee(s):
Unknown Unknown / Unknown

Date: 4/1/1999
DOCID: 1094774
Pages: 7
Releasable

NOAA web page excerpts regarding Coastal Cutthroat Trout, Coho and Chinook Salmon (reference 15).

Authors:
Unknown Unknown / NOAA

Addressee(s):
Unknown Unknown / Unknown

Date: 9/8/1999
DOCID: 1094770
Pages: 39
Releasable

Preliminary Natural Resource Survey, lower Willamette River (reference 11).

Authors:
Unknown Unknown / NOAA

Addressee(s):
Unknown Unknown / Unknown

Date: 2/18/2000
DOCID: 1094777
Pages: 77
Releasable

Sample quantitation limit calculations for samples collected as part of the Portland Harbor Sediment Investigation Report (reference 18).

Authors:
Mark Woodke / Ecology & Environment, Inc.

Addressee(s):
Linda Foster / Ecology & Environment, Inc.

Date: 5/30/2000
DOCID: 1094888
Pages: 65
Releasable

Hazard Ranking System documentation package. Document available in PDF format: http://www.epa.gov/superfund/sites/newprop.htm.

Authors:
Annette Sackman-Franzen / Ecology & Environment, Inc.

Addressee(s):
Monica Tonel / EPA

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 7/1/2000
DOCID: 1094890
Pages: 5
Releasable

Memorandum transmitting descriptions of seven proposed sites added to the National Priorities List in July 2000.Document available in PDF format: http://www.epa.gov/superfund/new/newnpl.htm

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 7/1/2000
DOCID: 1094891
Pages: 70
Releasable

Memorandum transmitting auxiliary information: National Priorities List, Propsed Rule and Final Rule.Document available in PDF format: http://www.epa.gov/superfund/new/newnpl.htm

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 7/6/2000
DOCID: 1094889
Pages: 6
Releasable

Letter transmitting support for the placement of Portland Harbor to the National Priorities List.

Authors:
John Kitzhaber / State of Oregon

Addressee(s):
Carol Browner / EPA

Date: 7/27/2000
DOCID: 1094886
Pages: 21
Releasable

National Oil and Hazardous Substance Pollution Contingency Plan-The National Priorities List for Uncontrolled Hazardous Waste Sites Proposed Rule Public Docket Index (NPL-U33).

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / EPA

Date: 7/27/2000
DOCID: 1094887
Pages: 7
Releasable

Federal Register Notice - NPL for Uncontrolled Hazardous Waste Sites, Proposed Rule (NPL-U33).

Authors:
Unknown Unknown / U. S. Federal Register

Addressee(s):
Unknown Unknown / Unknown

Date: 9/3/2000
DOCID: 1098816
Pages: 2
Releasable

Letter transmitting comments regarding the EPA proposal of Portland Harbor to the National Priorities List.

Authors:
Glen Carter / Unknown

Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 9/18/2000
DOCID: 1098817
Pages: 2
Releasable

Letter transmitting comments regarding the EPA proposal of Portland Harbor to the National Priorities List.

Authors:
Randall Butler / U. S. Army Corps of Engineers

Addressee(s):
Unknown Unknown / EPA

Date: 9/20/2000
DOCID: 1098818
Pages: 2
Releasable

Letter transmitting comments regarding the EPA proposal of Portland Harbor to the National Priorities List.

Authors:
Samuel Penney / Nez Perce Tribe

Addressee(s):
Unknown Unknown / EPA

Date: 9/22/2000
DOCID: 1098819
Pages: 5
Releasable

Letter transmitting comments regarding the EPA proposal of Portland Harbor to the National Priorities List.

Authors:
Cheryl Koshuta / Port of Portland

Addressee(s):
Unknown Unknown / EPA

Date: 9/22/2000
DOCID: 1098820
Pages: 1
Releasable

Letter transmitting comments on behalf of Time Oil Co. regarding the EPA proposal of Portland Harbor to the National Priorities List.

Authors:
Patricia Dost / Schwabe, Williamson & Wyatt, P.C.

Addressee(s):
Unknown Unknown / EPA

Date: 9/22/2000
DOCID: 1098909
Pages: 16
Releasable

Letter transmitting comments regarding the proposal of the Portland Harbor site to the National Priorities List (with attached letter from the Columbia River Inter-Tribal Fish Commission).

Authors:
Randy Settler / Confederated Tribes and Bands of the Yakima Indian N

Addressee(s):
Unknown Unknown / EPA

Date: 9/25/2000
DOCID: 1098855
Pages: 3
Releasable

Letter transmitting comments regarding the proposal of Portland Harbor to the National Priorities List.

Authors:
Bruce Brunoe / Confederated Tribes of the Warm Springs Reservation

Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.2 Vol. 1 NPL Dockets

Date: 9/25/2000
DOCID: 1098856
Pages: 11
Releasable

Letter transmitting comments regarding the proposal of Portland Harbor to the National Priorities List and attached Portland Harbor Cleanup Statement of General Principles.

Authors:
Michael Farrow / Confederated Tribes of the Umatilla Indian Reservatic
Unknown Unknown / Oregon Dept. of Environmental Quality

Addressee(s):
Unknown Unknown / EPA

Date: 9/25/2000
DOCID: 1098908
Pages: 4
Releasable

Letter transmitting comments regarding the proposal of the Portland Harbor site to the National Priorities List (with attached news article).

Authors:
Harry Demaray / Oregon Dept. of Environmental Quality

Addressee(s):
Unknown Unknown / EPA

Date: 12/1/2000
DOCID: 1081415
Pages: 26
Releasable

Support Document for the Revised National Priorities List Final Rule December 2000.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

Date: 12/1/2000
DOCID: 1138681
Pages: 27
Releasable

Region 10 portion of the Support Document for the Revised National Priorities List, Final Rule December 2000.

Authors:
Unknown Unknown / EPA

Addressee(s):
Unknown Unknown / Unknown

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 9/21/1987
DOCID: 693040
Pages: 18
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 2 - Guidance on the Use of Stipulated Penalties in Hazardous Waste Consent Decrees.

Authors:
Tom Adams / EPA

Addressee(s):
Unknown Unknown / EPA

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 11/6/2003
DOCID: 693047
Pages: 52
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(2) - Re: EPA Comments on LWG Field Sampling Plan EPA Alternate Field Sampling Plan.

Authors:
Tara Martich / EPA
Chip Humphrey / EPA

Addressee(s):
Robert Wyatt / Lower Willamette Group
Jim McKenna / Lower Willamette Group

Date: 3/15/2004
DOCID: 693044
Pages: 20
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(1)b - Re: Administrative Order on Consent for Remedial Investigation and Feasibility Study, RI/FS Work Plan.

Authors:
Chip Humphrey / EPA
Eric Blischke / Oregon Dept. of Environmental Quality

Addressee(s):
Jim McKenna / Lower Willamette Group
Robert Wyatt / Lower Willamette Group

Date: 12/21/2010
DOCID: 693061
Pages: 4
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(3)a - Re: Administrative Order on Consent for Remedial Investigation and Feasibiliy Study, Portland Harbor Feasibility Study.

Authors:
Chip Humphrey / EPA

Addressee(s):
Robert Wyatt / Lower Willamette Group

Date: 2/25/2011
DOCID: 693062
Pages: 8
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(3)b - Re: Administrative Order on Consent for Remedial Investigation and Feasibiliy Study, Schedule for Remedial Investigation and Feasibility Study,

Authors:
Chip Humphrey / EPA
Kristine Koch / EPA

Addressee(s):
Robert Wyatt / Lower Willamette Group
Jim McKenna / Lower Willamette Group

Date: 6/6/2011
DOCID: 693063
Pages: 1
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(3)c - Re: Alternatives Screening Stipulated Penalties.

Authors:
Chip Humphrey / EPA

Addressee(s):
Jim McKenna / Lower Willamette Group
Robert Wyatt / Lower Willamette Group
Kristine Koch / EPA

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 6/9/2011
DOCID: 693064
Pages: 1
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

EPA Response to LWG Dispute Exhibits: Exhibit 4(3)d - Re: Alternatives Screening Stipulated Penalties.

Authors:
Jim McKenna / Lower Willamette Group

Addressee(s):
Robert Wyatt / Lower Willamette Group
Jim McKenna / Lower Willamette Group
Kristine Koch / EPA

Date: 7/23/2012
DOCID: 696726
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-07-23 Dispute Resolution Supporting Documentation.

Authors:
Chip Humphrey / Department of Environmental Quality
Eric Blischke / Oregon Dept. of Environmental Quality

Addressee(s):
Kristine Koch / EPA

Date: 7/23/2012
DOCID: 696728
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-07-23 LWG Notice of Objection and Request for Dispute Resolution.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Kristine Koch / EPA
Chip Humphrey / EPA

Date: 7/23/2012
DOCID: 696729
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-07-23 Table 1 Deficiencies Identified by EPA in its June 22, 2012 Cover Letter.

Authors:
Kristine Koch / EPA

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/23/2012
DOCID: 696730
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-07-23 Table 2 General Categories of LWG Objections to EPA June 22, 2012 Revisions.

Authors:
Kristine Koch / EPA

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/23/2012
DOCID: 696731
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-07-23 Table of Contents For Dispute Resolution Package.

Authors:
Kristine Koch / EPA

Addressee(s):
Unknown Unknown / Lower Willamette Group

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 7/23/2012
DOCID: 705361
Pages: 1397
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Portland Harbor RI/FS Notice of Objection to EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution.

Authors:
Kristine Koch / EPA

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 7/23/2012
DOCID: 1432318
Pages: 25
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Notice of Objection to EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Chip Humphrey / EPA
Kristine Koch / EPA

Date: 9/21/2012
DOCID: 696740
Pages: 6221
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

2012-09-21 - SUPPORTING DOCUMENTATION.

Authors:
Kristine Koch / EPA

Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 9/21/2012
DOCID: 1432322
Pages: 225
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Lower Willamette Group Opening Submission - Formal Dispute on EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Kristine Koch / EPA

Date: 9/21/2012
DOCID: 1432444
Pages: 172
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Supporting Documentation for the July 12, 2013 LWG Combined Notice of Objection and Request for Dispute Resolution of EPA's Notice of Demand for Payment of Stipulated Penalties Regarding BHHRA and Request for Determination.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Richard Albright / EPA
Kristine Koch / EPA
Chip Humphrey / EPA

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 10/24/2012 2012-10-24 - TABS 50-54 SUPPORTING DOCUMENTS (2).
DOCID: 696737
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Kristine Koch / EPA
Addressee(s):
Unknown Unknown / Lower Willamette Group

Date: 10/24/2012 Lower Willamette Group Reply to EPa Submission Formal Dispute on EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution.
DOCID: 1432323
Pages: 30
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Unknown Unknown / Lower Willamette Group
Addressee(s):
Daniel Opalski / EPA

Date: 10/25/2012 Formal Dispute on the EPA Notice of Non-Complianc and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution: Partial Resolution.
DOCID: 143216
Pages: 0
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Daniel Opalski / EPA
Addressee(s):
Daniel Opalski / EPA

Date: 10/25/2012 Memorandum regarding Formal Dispute on the EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution, Partial Resolution.
DOCID: 1432316
Pages: 2
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Daniel Opalski / EPA
Addressee(s):
Kristine Koch / EPA

Date: 4/10/2013 EPA Response to LWG Dispute Exhibits: Exhibit 3 - Re: Notice of Assessment and Demand for Payment of Stipulated Penalties; Administrative Settlement Agreement and Order on Consent for Remedial Investigation and Feasibility Study.
DOCID: 693041
Pages: 3
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Lori Cohen / EPA
Addressee(s):
Bob Wyatt / Lower Willamette Group

Date: 4/10/2013 EPA Response to LWG Dispute Exhibits: Exhibit 4(1)a - Re: EPA Response and Comments on the Portland Harbor RI/FS Programmatic Work Plan, March 31, 2003.
DOCID: 693042
Pages: 68
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Authors:
Chip Humphrey / EPA
Addressee(s):
Robert Wyatt / Lower Willamette Group
Jim McKenna / Lower Willamette Group

SUB-HEAD: 1.3 Vol. 1 Dispute Resolution Documents

Date: 7/12/2013
DOCID: 1432443
Pages: 18
Releasable
(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

Re: Combined Notice of Objection to and Request for Dispute Resolution of EPA's Notice of Demand for Payment of Stipulated Penalties regarding Baseline Human Health Risk Assessment and Request for Determination; Lower Willamette River.

Authors:
Unknown Unknown / Lower Willamette Group

Addressee(s):
Kristine Koch / EPA
Chip Humphrey / EPA
Richard Albright / EPA

(Contains ELECTRONIC REC
(Contains OPTICAL STORAG

To: Robinson, Deborah[Robinson.Deborah@epa.gov]; Townsend, Tom[Townsend.Tom@epa.gov]; Poland, Melody[Poland.Melody@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; Tom Roick - ODEQ (ROICK.Tom@deq.state.or.us)[ROICK.Tom@deq.state.or.us]; Kevin Parrett (parrett.kevin@deq.state.or.us)[parrett.kevin@deq.state.or.us]; Keith Johnson - ODEQ (johnson.keith@deq.state.or.us)[johnson.keith@deq.state.or.us]; DECONCINI Nina[DECONCINI.Nina@deq.state.or.us]; gilles.bruce@deq.state.or.us[gilles.bruce@deq.state.or.us]; Zhen, Davis[Zhen.Davis@epa.gov]
Cc: Bill Ross (bross@rossstrategic.com)[bross@rossstrategic.com]
From: Conley, Alanna
Sent: Wed 12/9/2015 9:06:26 PM
Subject: RE: Today's EPA/DEQ meeting will be in separate offices
Overview of EPA's public involvement and communication process.pptx

ODEQ partners,

The community involvement presentation for the meeting is attached.

Thanks

From: Robinson, Deborah
Sent: Wednesday, December 09, 2015 10:26 AM
To: Townsend, Tom <Townsend.Tom@epa.gov>; Poland, Melody <Poland.Melody@epa.gov>; Christopher, Anne <Christopher.Anne@epa.gov>; Conley, Alanna <conley.alanna@epa.gov>; Tom Roick - ODEQ (ROICK.Tom@deq.state.or.us) <ROICK.Tom@deq.state.or.us>; Kevin Parrett (parrett.kevin@deq.state.or.us) <parrett.kevin@deq.state.or.us>; Keith Johnson - ODEQ (johnson.keith@deq.state.or.us) <johnson.keith@deq.state.or.us>; DECONCINI Nina <DECONCINI.Nina@deq.state.or.us>; gilles.bruce@deq.state.or.us; Zhen, Davis <Zhen.Davis@epa.gov>
Cc: Bill Ross (bross@rossstrategic.com) <bross@rossstrategic.com>
Subject: Today's EPA/DEQ meeting will be in separate offices

Hello,

This is to confirm emails I have had with individuals.

Because today's EPA/DEQ Staff/Management meeting is short, and there is an hour break between the portions of the meeting, we will meet in our separate offices. We won't use VTC for today's meeting.

Melody and Tom, please make the conference room available for other users; however we are still slated to use the OOO conference phone line.

Thanks,

Debbie

====================================
From the Desk of:
Debbie Robinson
Tel: 206-553-4961
robinson.deborah@epa.gov

US EPA Region 10, M/S ECL 122, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101

Overview of EPA’s public involvement and communication process

- Phases of EPA’s community involvement process leading up to and after the proposed plan
- Target audiences
- External coordination and communication efforts

Pre-proposed Phase

Dec 2015-March 2016

Goal: Prepare community for public comment period

- Strategic outreach to targeted audiences
- Messaging: risks, why EPA is taking action, discussion of alternatives, pre-view of public comment process
- Public feedback concerns, expectations

Proposed Plan Phase

March/April – June 2016

Goal: Encourage public participation & collect public comments

- RI/FS and Proposed plan released + Fact Sheet/FAQ
- Public notice: Availability of RI/FS, Proposed Plan, public comment period via various media sources
- Public meetings: Proposed Plan and supporting information (4 City wide meetings)
- Public comment: Sessions court reporters (60 Days)
- Meeting transcript

Post Proposed Plan Phase

June/July 2016 – Dec 2016

Goal: Agency response to comments

- Notice of proposed settlement published in FR
- Responsiveness summary
- Explanation of significant differences

Pre-Proposed Plan Engagement

Under-represented, vulnerable communities

Immigrant, ESL, Houseless, Urban Tribal

- Dec 15 – OTW/College Students
- Jan 31 – Earth Care Summit
- Jan/Feb- Comm. of Color, NAYA, Latino Net
- Jan/Feb – Neighborhood Association

Non-Profit

Funded, influential, politically active, visible

- Feb 9th – League Women Voters
- Feb – Audubon/Willamette Riverkeeper
- Jan/Feb- Citizen's Utility Board Oregon
- Ongoing- CAG

General public

Reach large audience – interested but not actively engaged

- Jan-March: Well advertised public information sessions (3)
- Jan/Feb: Swan Island Business Assoc.

Coordination and communication

Comprehensive Communication Plan

- Tribes
- Local elected officials
- Congressional delegation
- State/Federal agencies
- Media
- PRPs
- Administrator

Coordination Efforts

- ODEQ
- City of Portland
- Portland Neighborhood Services

To: Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Audie Huber (audiehuber@ctuir.com)[audiehuber@ctuir.com]; Blischke, Eric[blischkee@cdmsmith.com]; brandy.humphreys@grandronde.org[brandy.humphreys@grandronde.org]; Brian Cunninghame (cunninghame@gorge.net)[cunninghame@gorge.net]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; Coffey, Scott[CoffeySE@cdmsmith.com]; Conley, Alanna[conley.alanna@epa.gov]; Courtney Johnson (courtney@crag.org)[courtney@crag.org]; Elmer Ward[elmer.ward@ctwsbnr.org]; Fuentes, Rene[fuentes.rene@epa.gov]; Gabriel Moses **Personal Privacy / Ex. 6** Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Hagerman, Paul[HagermanPR@cdmsmith.com]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; JD Williams (jd@williamsjohnsonlaw.com)[jd@williamsjohnsonlaw.com]; Jeanette Mullin (mullinjm@cdmsmith.com)[mullinjm@cdmsmith.com]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; Julie Weis (jweis@hk-law.com)[jweis@hk-law.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Morrison, Kay[morrison.kay@epa.gov]; Paul Bianco[paul@ridolfi.com]; rdelvecchio@indecon.com DelVecchio[RDelVecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Shephard, Burt[Shephard.Burt@epa.gov]; Todd King (KingTW@cdmsmith.com)[KingTW@cdmsmith.com]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; Tom Roick (roick.tom@deq.state.or.us)[roick.tom@deq.state.or.us]; Zhen, Davis[Zhen.Davis@epa.gov]
Cc: Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]; Charters, David[Charters.DavidW@epa.gov]
From: Koch, Kristine
Sent: Thur 7/9/2015 5:45:22 PM
Subject: LWG 7/8/15 presentation to the CAG
LWG July 8 2015 PH CAG presentation - FINAL.PDF

All – Here is the presentation the LWG gave to the CAG last night.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
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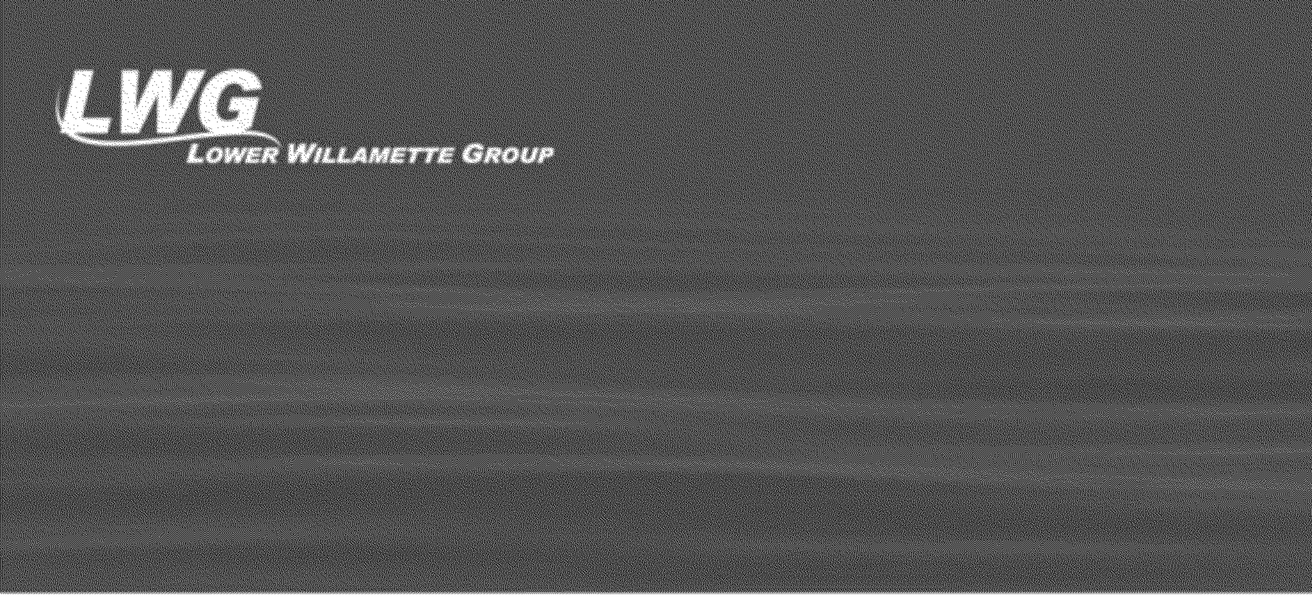


Portland Harbor Superfund Site

Portland Harbor Community Advisory Group
July 8, 2015
Jim McKenna
Barbara Smith

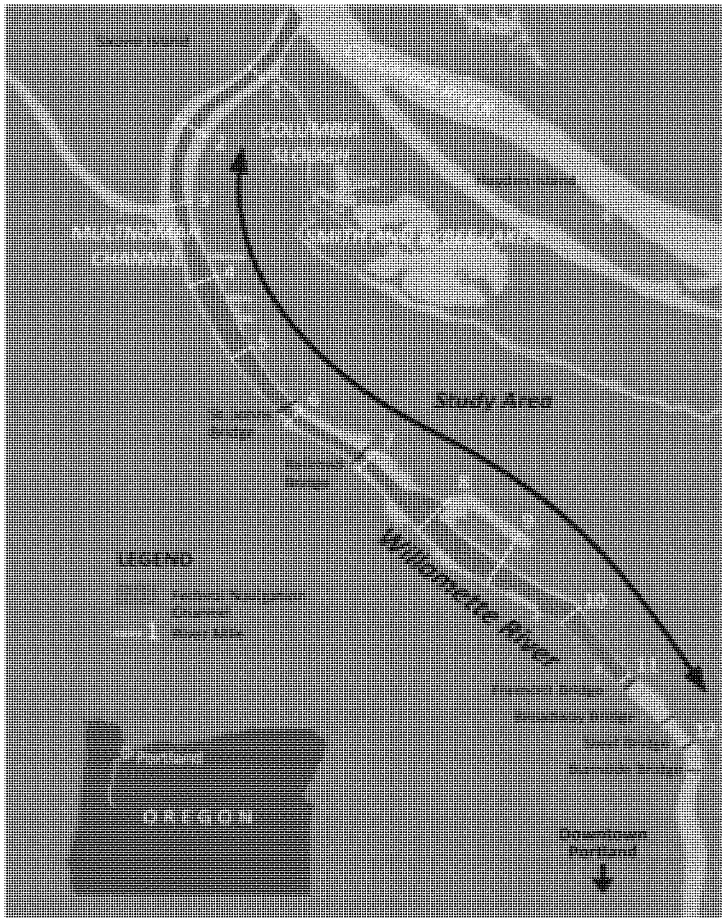
2015

Presentation Overview

Objective: Summarize LWG's conceptual approach for a protective, timely, cost-effective cleanup of the Site

- What we know about the dynamic features of the river
- What we know about contamination
- What we know about risks to human health and the environment
- What the LWG expects for the cleanup

Portland Harbor Superfund Site



- Listed as Superfund Site 2000
- U.S. EPA (in water) and Oregon DEQ (upland) leading cleanup
- Lower Willamette Group – 12 businesses, 2 public entities funding the Remedial Investigation/Feasibility Study
- Many more PRPs identified

Superfund
One of many river programs

- Superfund focuses on reducing risks from contaminants in river sediment and controlling sources of contaminants to the Site

- Other programs focus on improving water quality

  - "Big Pipe" Combined Sewer Overflow Abatement - City of Portland
  - Oregon Water Quality Management (TMDLS) - Oregon DEQ

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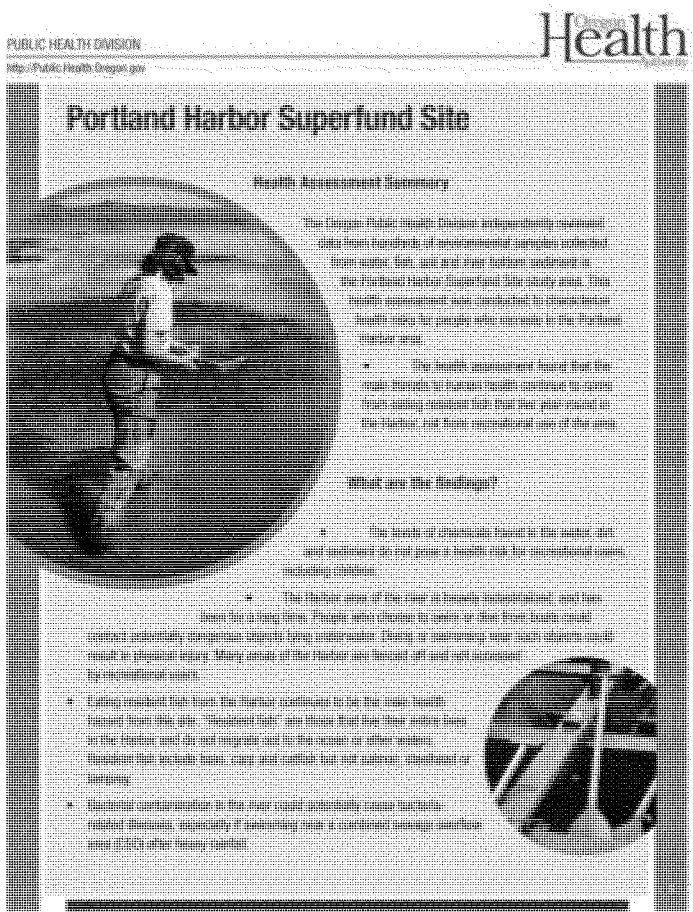
Oregon Division of Human Services Environmental Health Assessment Program – fish advisories and health assessments


PUBLIC HEALTH DIVISION
http://Public.Health.Oregon.gov
Health

Portland Harbor Superfund Site

Health Assessment Summary

What are the findings?

What we know about river dynamics

- The Lower Willamette River flows slower in wider areas
- Most areas in Portland Harbor are depositional
- In most areas, cleaner (less contaminated) upstream sediments are continually deposited on downstream surface sediments

What we know about contamination

- Contaminants in sediments mainly from historical releases
- Mostly in near shore areas, not navigation channel
- Higher concentrations are buried in stable subsurface sediments
- Potential risks from contaminants in surface sediments primarily from four chemical groups
  - PCBs
  - Dioxin/furans
  - DDT and breakdown products
  - PAHs (polycyclic aromatic hydrocarbons)
- Numerous other contaminants contribute to potential risk

What we know - human health risks

- Little or no potential unacceptable risk to general public from water or sediment contact

- Primary potential human health risk is from long-term consumption of resident fish (bass)

- Much lower potential risk from consumption of migratory fish (salmon)

What the LWG expects

- EPA process will consider public comment
  - CAG has already had substantial impact
  - Formal public comment period with Proposed Plan
- Assume ongoing sources will be controlled at the time of the cleanup
  - Many DEQ upland cleanups already successful
- Some risks will remain
  - Mercury is a regional problem – not just at the Site – fish advisory will remain
  - Background concentrations for some contaminants exceed EPA risk criteria (e.g., naturally occurring arsenic)

LWG Key Considerations

(Based on EPA Superfund Regulations & Guidance)

1. Achievable Cleanup Goals
2. Combination of Technologies
3. Natural Recovery
4. Short Term Impacts
5. Cost Effectiveness
6. Flexibility

Achievable Cleanup Goals

Cleanup goals should be achievable through sediment cleanup and source control

- Focus on ***reducing*** risk to human health and the environment to acceptable levels – cannot eliminate all risks
- Cleanup goals should not be set below what is practically achievable

Achievable Cleanup Goals

- Risk management needs to be incorporated when setting cleanup goals
  - Risk management
    - compare, rank, and prioritize risks and
    - compare and contrast the costs, benefits, and time of cleanup options to reduce risks
  - Example: “Meals per month” can be used to assess risk reduction by comparing the number of meals of resident fish that can be consumed per month before and after the cleanup is completed

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Combination of Technologies

Each alternative in the Feasibility Study should use a combination of technologies – dredging, capping, and monitored natural recovery

- Mass removal of contaminated sediment should not be presumed to be more effective than other technologies in achieving risk reduction over time

- The length of time and cost to achieve cleanup goals are important factors in evaluating combinations of technologies

Natural Recovery

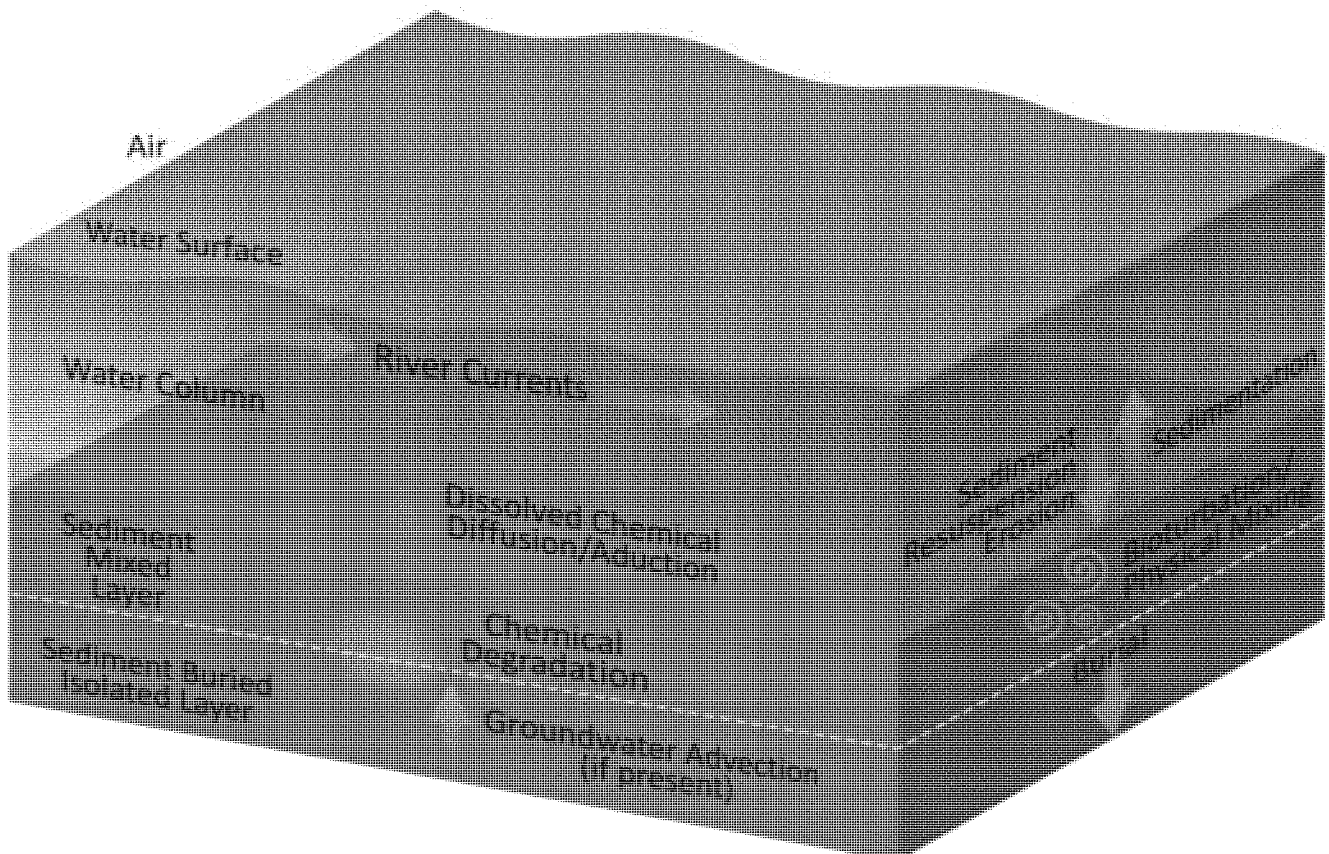
Natural recovery is occurring and will help achieve cleanup goals over time.

- Dynamic river system – lots of incoming cleaner sediment
- Source control has reduced input of contaminants to the Site
- Natural recovery will be monitored and can be enhanced with amendments (e.g., organic carbon)

Natural Recovery

- Data collected in 2012 for EPA shows contaminants in fish tissue decreased by about 40% since 2002
- Contaminants in surface sediments continue to decrease
- Some near-shore areas will not recover within a reasonable time without active cleanup

Natural Recovery



Short Term Impacts

Examples of short term impacts associated with in-water cleanup (dredging or capping):

- Dredging or capping may release contaminants into the water and temporarily increase contaminants in fish
  - Measures to control releases during in-water work only partially effective and add more cleanup time
  - Dredging machinery poses on-the-job safety risks to workers
  - In-water operations can interfere with harbor traffic

Cost Effectiveness

- FS should evaluate whether estimated costs are proportional to effectiveness of cleanup options in reducing risk

- Cost estimates should include all reasonably anticipated factors (production rates, dock removal, and mitigation, etc.)

- Cost estimates should be based on costs and duration seen on recent projects

Flexibility

Provide opportunities before and after remedy selection to incorporate new data, current and future uses of shoreline, and potential technical innovations to achieve cleanup goals

- New data and information can come from:
  - Remedial design/remedial action
  - Location-specific considerations
  - Long-term monitoring

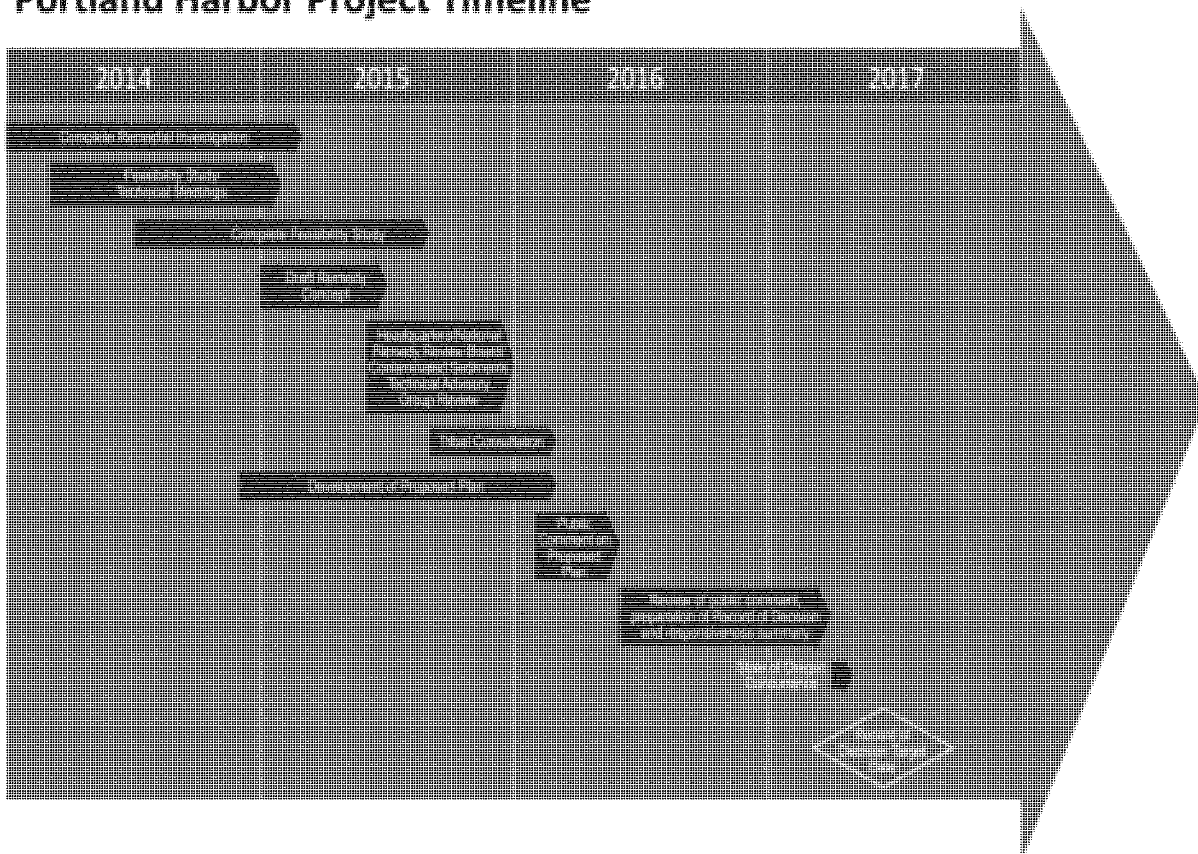
Questions?

lwgportlandharbor.org

LWG
Lower Willamette Group

EPA estimated timeline

Portland Harbor Project Timeline



To: Allen, Elizabeth[allen.elizabeth@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; Conley, Alanna[conley.alanna@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Zhen, Davis[Zhen.Davis@epa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; DeMaria, Eva[DeMaria.Eva@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]
From: Sheldrake, Sean
Sent: Fri 9/18/2015 4:49:06 PM
Subject: FW: Five Tribes Review of RM11E Draft Implementability Study Report
Five Tribes Review of RM11E Draft Implementability Study Report

All, fyi…. Again, let me know if you are planning on reviewing this one so I can pace the comments accordingly, otherwise I'll work on cross walking consistency with the draft FS in developing EPA's comment set. Thank you. S

Sean Sheldrake, Unit Diving Officer, RPM

EPA Region 10, 1200 Sixth Ave., Suite 900; Mailstop DOC-01

Seattle, WA 98101

206.553.1220 desk

206.225.6528 cell

http://yosemite.epa.gov/r10/cleanup.nsf/sites/ptldharbor

http://www.epa.gov/region10/dive/

206.553.6379 Dive Operations Center

206.369.7500 Dive Unit cell

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From: Sheldrake, Sean
Sent: Friday, September 18, 2015 9:46 AM
To: 'Rita Cabral'
Cc: 'Julie Weis'; Michael.karnosh@grandronde.org; brandy.humphreys@grandronde.org; 'Holly Partridge'; tomd@ctsi.nsn.us; 'cunninghame@gorge.net'; 'Elmer Ward - Confederated Tribes of the Warm Springs Reservation of Oregon (elmer.ward@ctwsbnr.org) (elmer.ward@ctwsbnr.org)'; 'courtney@crag.org'; 'Gabriel Moses Personal Privacy / Ex. 6 Rachel DelVecchio; Gail Fricano; Tom Fredette (tomfredette@outlook.com)
Subject: RE: Five Tribes Review of RM11E Draft Implementability Study Report

Rita,

Thank you for the Tribes' comments. We'll incorporate into our comment set or get back with you to discuss further.

Thank you.

S

Sean Sheldrake, Unit Diving Officer, RPM

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From: Rita Cabral [mailto:RCabral@indecon.com]
Sent: Monday, September 14, 2015 2:06 PM
To: Sheldrake, Sean
Cc: 'Julie Weis'; Michael.karnosh@grandronde.org; brandy.humphreys@grandronde.org; 'Holly

Partridge'; tomd@ctsi.nsn.us; 'cunninghame@gorge.net'; 'Elmer Ward - Confederated Tribes of the Warm Springs Reservation of Oregon (elmer.ward@ctwsbnr.org) (elmer.ward@ctwsbnr.org)'; 'courtney@crag.org'; 'Gabriel Moses **Personal Privacy / Ex. 6** Rachel DelVecchio; Gail Fricano; Tom Fredette (tomfredette@outlook.com)
Subject: Five Tribes Review of RM11E Draft Implementability Study Report

Hello Sean,

Thank you for the opportunity to comment on the RM11E Draft Implementability Study Report. Attached are comments on behalf of the Five Tribes. Please let me know if you have any questions or would like to set up a call to discuss the comments.

Best regards,

Rita

Rita Cabral, Ph.D.
Associate
Industrial Economics, Incorporated (IEc)
2067 Massachusetts Ave.
Cambridge, MA 02140

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To: Sheldrake, Sean[sheldrake.sean@epa.gov]
Cc: 'Julie Weis'[JWeis@hk-law.com]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; brandy.humphreys@grandronde.org[brandy.humphreys@grandronde.org]; 'Holly Partridge'[Holly.Partridge@grandronde.org]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; 'cunninghame@gorge.net'[cunninghame@gorge.net]; 'Elmer Ward - Confederated Tribes of the Warm Springs Reservation of Oregon (elmer.ward@ctwsbnr.org) (elmer.ward@ctwsbnr.org)'[elmer.ward@ctwsbnr.org]; 'courtney@crag.org'[courtney@crag.org]; 'Gabriel Moses **Personal Privacy / Ex. 6** **Personal Privacy / Ex. 6** Rachel DelVecchio[RDelVecchio@indecon.com]; Gail Fricano[GFricano@indecon.com]; Tom Fredette **Personal Privacy / Ex. 6**
From: Rita Cabral
Sent: Mon 9/14/2015 9:06:09 PM
Subject: Five Tribes Review of RM11E Draft Implementability Study Report
5 Tribes Comments on RM11E ISR_IEc_14Sept2015.docx

Hello Sean,

Thank you for the opportunity to comment on the RM11E Draft Implementability Study Report. Attached are comments on behalf of the Five Tribes. Please let me know if you have any questions or would like to set up a call to discuss the comments.

Best regards,

Rita

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MEMORANDUM | September 14, 2015

TO Sean Sheldrake, U.S. Environmental Protection Agency, Region 10

FROM Rita Cabral, Tom Fredette, and Gail Fricano (IEc)

SUBJECT Comments on Draft Implementability Study Report for RM11E, Portland, Oregon

This memorandum provides comments on behalf of the Five Tribes[1] on the RM11E Group's Draft Implementability Study Report (ISR) for River Mile 11 East (RM11E) on the Willamette River. This abovementioned report was written to support their Supplemental RI/FS Investigation.

The Supplemental RI/FS Investigation at this site has the goal of undertaking further characterization, study, and analysis of the RM11E project area to fill existing data gaps and support the preliminary remediation design for RM11E, through the conduct of field work, research, and preparation of supplemental study reports.

One such supplemental study report is the ISR. This report works to assess waterfront activities and uses, structures existing along the waterfront, subaqueous debris, and other environmental topics (e.g., riverbank stability and slopes, hydrodynamics) in order to determine how these factors may impact the selection of a remedy. The report identifies and assesses these constraints and also identifies remediation technologies that can be adapted to these conditions.

Below we present our comments by topic.

GENERAL IMPLEMENTABILITY STUDY REPORT COMMENTS

(1) We recommend including additional citations and references to support the methods used in this report (both analytical and field) as well as some of the statements made throughout the report. Providing examples of other locations or projects where a particular method was successfully used would also bolster the findings presented here. Specific examples of where additional citations would be beneficial are provided within the individual sections, below. However, this issue was ubiquitous throughout the report and only several instances are provided as examples.

(2) Many locations in the document make reference to the use of a sand cap. "Sand cap"

[1] The Five Tribes are the Confederated Tribes of the Grand Ronde Community of Oregon, the Nez Perce Tribe, the Confederated Tribes of Siletz Indians of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes of the Warm Springs Reservation of Oregon.

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is a very prejudicial term and serves to potentially limit the source options for cap material. Sandy materials with silt or clay mixed in have potential to provide a much more effective cap, and depending on the material and application, may be applied with equal ease. Elsewhere in the document the term "cover material" is used and this is a much less prejudicial term. Palermo et al. (1998) used "sandy" as opposed to "sand" for precisely the reason addressed above, so as to not be prejudicial. Further, they go on to make the explicit point that sand might not be the optimal choice for caps (Palermo et al. 1998, p. 74). The ISR should only refer to a sand cap when it is in reference to a specific intentional choice for a project made after appropriate evaluation. We strongly suggest using "cover material" or some other generic term for this report.

SPECIFIC IMPLEMENTABILITY STUDY REPORT COMMENTS

SECTION 2: MAPPING

(3) Task 3 states that the data representing structures above the dock surface were not processed, but remain in the raw data set if needed at a later date. Figure 2.2 accompanying this text appears to have blue outlines representing the footprint of some dock surfaces. We suggest providing a description of how these outlines were generated and what they represent.

(4) The mapping section also contains language that "conventional survey methods" were used, but no sources are provided to support that these methods are conventional (e.g., first paragraph of Section 2.2.2).

SECTION 3: WATERFRONT ACTIVITIES AND USES

(5) Table 3.8 provides a list of shoreline modifications for the various waterfront facilities. Glacier NW stated that a retaining wall had collapsed at the northern end of its property and that the bank behind the main dock was armored with riprap when the dock was replaced in 2000-2002, and that vegetation was planted. As stated, the timeline of retaining wall collapse is unclear. We suggest clarifying whether or not the retaining wall was replaced with rip rap and vegetation or whether the rip rap, vegetation, and dock replacement occurred before the retaining wall collapsed. In other words, did these events occur to the same bank or to different banks?

(6) During the discussion of past dredging events, the extent of contamination was not discussed. Past dredging events could provide valuable information related to the distribution of contaminants at the site, particularly with regard to generated residuals. If contaminant sampling had not been done in relationship to these dredge events then it should be clearly stated that this is why contaminant concentrations related to past dredging event are not discussed. Otherwise, we suggest including discussion of contaminant concentrations related to these events.

SECTION 4: DEBRIS SURVEY

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(7) It is unclear why the anthropogenic armoring described in Section 4.3.1 is not evaluated in this report. The ISR is meant to identify and assess site constraints that will need to be considered and addressed as part of the remedial design for the RM11E project area. The anthropogenic armoring was identified, but not evaluated. We suggest evaluating the limitations this armoring would have on a remedy.

(8) Section 4.3.1.2 indicates that there are several management alternatives available for working with embedded individual large debris, but that their cost, effectiveness, and impacts would be evaluated during remedial design work. We suggest describing, or at least mentioning, the alternatives or the classes of management alternatives here even if they will be more thoroughly evaluated later. Currently, the reader could not know the types of management alternatives that are being considered.

SECTION 5: GEOTECHNICAL ASSESSMENT

(9) Section 5.2.3 describes the new inclinometer data that were obtained in this assessment. However, no reference is provided for the methods of this measurement. This section would be strengthened by a methods reference, an example of a successful implementation of this method elsewhere, and/or justification for only using three inclinometers.

(10) We suggest reducing the ambiguity in Section 5.3.1 regarding what is shoreline slope and what is riverbank. Currently, slope is used for describing both subaerial and subaqueous slopes, which creates confusion when discussing how the slope is armored (e.g., with vegetation). Please use consistent language when describing subaerial and subaqueous slopes in this section.

(11) There are several examples of statements that could be better supported by providing additional references and/or examples.

- Page 5-7 states "In the long term, these slopes will generally erode or slough back to at least 2H:1V in sand, 2.5H:1V in silt, or 1.5H:1V in gravel." No citation is currently provided to support this assertion.
- Page 5-8 states "Place fill to reestablish site grades, if necessary, from the bottom of the excavation and at slopes flatter than about 2H:1V to 3H:1V, depending on material." The reason for advising slopes flatter than 2H:1V to 3H:1V could be better supported. The reason for choosing this threshold is unclear.
- Page 5-12 states "As shown on Figure 5.14, these lateral forces can be modeled on a preliminary basis using an equivalent fluid weight of 55 pounds per cubic foot." It is unclear why this is a reasonable equivalent fluid weight to use for the modeling.

(12) Section 5.3.7.3 apparently confuses the matrix type that is being discussed. It outlines that dredging activities will reduce the amount of available soil to resist lateral loading and could potentially undermine the tips of relatively shallow piles. However, it is sediment that would be dredged, not soil.

(13) Section 3 mentions that the Federal navigation channel has been authorized to -43

feet CRD, three feet deeper than its current -40 feet CRD. Figure 5.14 suggests a need to consider this future navigation channel deepening and the effect it might have on nearby slopes and potential remediation options. We think a thorough discussion of this channel deepening is warranted.

SECTION 6: STRUCTURAL ASSESSMENT

(14) Table 6.1 makes no reference to a building on the Unkeles property. We suggest including this property in the discussion or providing the rationale for its exclusion.

(15) The potential interference of the Fremont Bridge on remediation activities is not sufficiently discussed. The existence of the bridge may affect the machinery that is expected to work under it, and its foundations may limit remediation activities. We suggest including a more thorough discussion of this structure.

SECTION 8: SUMMARY OF FACTORS THAT AFFECT IMPLEMENTABILITY

(16) Section 8.1 ("high-ranked site factors") does not sufficiently address the potential Federal navigation channel deepening. We suggest including a more thorough discussion of the effects channel deepening would have on the site area and potential remediation options.

SECTION 9: IMPLEMENTABILITY CONSIDERATIONS

(17) Section 9.2.1.1 includes a general statement that 45% of the site has constrained access. The driver of this constraint is not discussed; it would be useful to know if there is one consistent factor or if it is due to a combination of factors. For example, is it primarily due to the ability of getting a single piece of equipment into the site? We suggest providing additional information regarding this topic.

- This section provides another example of where "sand" layer is used, and it introduces an automatic, unnecessary prejudice.

(18) In Section 9.2.2.4.1, a reference is made to other successful capping projects. They should be cited by reference.

(19) Related to Section 9.2.3.2.4, there has been no meaningful discussion of the potential for removal of any of the existing structures. Some discussion of which structures are most likely to be removed and which are not likely (and why) should be presented.

(20) Section 9.2.3.5.1 should mention that residuals would also require a final cover layer, which would contribute to reducing RALs.

- Additionally, we suggest citing a defendable study that supports the statement that debris is a primary factor in the generation of residuals. What percentage increase has been shown to occur when debris is present?
- This section provides another example of where "sand" layer is used, and it introduces an automatic, unnecessary prejudice.

SECTION 10: CONCLUSIONS AND RECOMMENDATIONS

(21) Section 10.2.7 outlines technologies that could be used for oversteepened slopes and includes rock buttressing, retaining walls at the toe of the shoreline slope, intermediate retaining walls, and the use of articulated concrete caps. We suggest including an evaluation of reactive core mats made of geotextiles for use in some areas of the site. Only articulated concrete mats are discussed in this context, but other options should be included. This comment applies to other locations in the document where articulated concrete mats are also mentioned.

REFERENCES

Palermo, M.R., Clausner, J.E., Rollings M.P., Williams, G.L., Myers, T.E., Fredette, T.J., and R.E. Randall. 1998. Dredging Operations and Environmental Research Program Guidance for Subaqueous Dredged Material Capping. US Army Corps of Engineers Waterways Experiment Station. Prepared for Headquarters, U.S. Army Corps of Engineers. Technical Report DOER-1. June. http://el.erdc.usace.army.mil/dots/doer/pdf/trdoer1.pdf

To: Koch, Kristine[Koch.Kristine@epa.gov]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; DeMaria, Eva[DeMaria.Eva@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]
From: Sheldrake, Sean
Sent: Mon 8/10/2015 8:42:12 PM
Subject: 11e implementability report
Transmittal of the Draft Implementability Study Report for River Mile 11E

K, E (and all), The more I look at this report the more I think we'lll need more time to cross walk it with the FS for consistency (you'll see the state asked for extra time, and we may actually need more time on our side). I'm going to ask CDM to do FS guidance checks and checks with the PH FS as it sits now, but I'll want to make sure this doesn't impact schedule on the harbor side of things. A lot of good information there, but some characterizations will have to be pulled back in terms of how we couched dock area levels of Implementability in our tech screening, at which point I'll get this sent to the AR.

Absent any of you participating in the review, I'll get the comment set drafted with those marching orders and get it back to the team in a few weeks.

Thoughts?

Thank you.

S

Sean Sheldrake, Unit Diving Officer, RPM

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From: Sheldrake, Sean
Sent: Monday, August 10, 2015 1:37 PM
To: 'HAFLEY Dan'
Cc: Lance Peterson (PetersonLE@cdmsmith.com)
Subject: RE: Draft 11E passive sampling comment set

Dan, The latter works for me. We may have to delay it further as I'm going to need to cross walk the comment set with EPA guidance and our FS of course, as in my quick read there's a lot of FS-y stuff in there that's not consistent with our guidance.

Thank you!

S

Sean Sheldrake, Unit Diving Officer, RPM

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From: HAFLEY Dan [mailto:HAFLEY.Dan@deq.state.or.us]
Sent: Monday, August 10, 2015 12:15 PM
To: Sheldrake, Sean
Subject: RE: Draft 11E passive sampling comment set

Sean –

Would end of August or first week of September (prefer the latter) be acceptable?

From: Sheldrake, Sean [mailto:sheldrake.sean@epa.gov]
Sent: Monday, August 10, 2015 10:57 AM
To: HAFLEY Dan
Cc: Lance Peterson (PetersonLE@cdmsmith.com)
Subject: RE: Draft 11E passive sampling comment set

Thanks Dan—they haven't gone out yet, but hopefully soon. I just wanted to check in since Jennifer was so heavily involved before I did.

I'm working on a due date for that report in looking at cdm capacity as well as partner workload. Do you have thoughts based on the DEQ workload you've got right now so we try to sync up with that?

S

Sean Sheldrake, Unit Diving Officer, RPM

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From: HAFLEY Dan [mailto:HAFLEY.Dan@deq.state.or.us]
Sent: Saturday, August 08, 2015 11:17 AM
To: Sheldrake, Sean
Subject: RE: Draft 11E passive sampling comment set

Sean –

Sorry I did not get to this sooner; workload is rather onerous at the moment…

We're glad that the comments were helpful, and I assume that they have gone out/or will be going out to the RM11E Group. We will begin review of the *Draft Implementability Study Report* – do you have a "due date" for DEQ comments?

Thanks.

DH

From: Sheldrake, Sean [mailto:sheldrake.sean@epa.gov]
Sent: Wednesday, August 05, 2015 1:43 PM
To: HAFLEY Dan; PETERSON Jenn L
Cc: MCCLINCY Matt; Lance Peterson (PetersonLE@cdmsmith.com)
Subject: Draft 11E passive sampling comment set

Hi Dan and Jennifer,

I really appreciate your work on polishing up this data set. I just wanted to get you this draft before I transmit in case you want to take a quick look to verify we captured things as you intended.

There are also comments here I may recycle into ORD's "user's guide" for passive sampler characterization of sediment, if you don't mind; I think there are some valuable lessons and subtle details here that are applicable elsewhere.

See (some of you) tomorrow and Friday-

S

Sean Sheldrake, Unit Diving Officer, RPM

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To: Sheldrake, Sean[sheldrake.sean@epa.gov]
Cc: 'Betz, Jan'[Jan.Betz@portlandoregon.gov]; 'Bryan Wigginton'[bwigginton@calportland.com]; 'Dave Livesay'[DLivesay@gsiws.com]; ''Denis Roznowski'[droznowski@foth.com]; 'Erin Carroll Hughes'[EcHughes@gsiws.com]; 'Ford, Bill (LG)'[WFord@LATHROPGAGE.COM]; 'Groy, Jeff'[Jeff.Groy@cbs.com]; 'Jeff Dresser'[jdresser@bridgeh2o.com]; ''Kathryn R. Huibregtse'[khuibregtse@environcorp.com]; 'Kim.Cox@portlandoregon.gov'['Kim.Cox@portlandoregon.gov']; 'KIRK.WILKINSON@lw.com'['KIRK.WILKINSON@lw.com']; 'Klinger, Nanci'[Nanci.Klinger@portlandoregon.gov]; 'Libby Smith'[LSmith@gsiws.com]; 'Matt Wells'[wells@tmw-law.com]; mhahn@environcorp.com[mhahn@environcorp.com]; 'Michelle Rosenthal'[Michelle@verislawgroup.com]; 'Paul Fuglevand'[pfuglevand@dofnw.com]; 'Rick Ernst'[rick.ernst@hartcrowser.com]; ''Russ P Cepko'[Russ.Cepko@cbs.com]; 'Sanders, Dawn'[Dawn.Sanders@portlandoregon.gov]; Till, Dustin[Dustin.Till@pacificorp.com]; Tim Thompson[tthompsonseellc@gmail.com]; Wiencke, Mary[Mary.Wiencke@pacificorp.com]; Nancy Case O'Bourke (ncase@dofnw.com)[ncase@dofnw.com]; Scott Schlechter[SSchlechter@gri.com]; Jon Dasler[jld@deainc.com]; Stephen Whittington[stephen.whittington@kpff.com]; ''Alex Liverman'[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; ''Audie Huber'[audiehuber@ctuir.com]; Bob Dexter[bob@ridolfi.com]; brandy.humphreys@grandronde.org[brandy.humphreys@grandronde.org]; ''Brian Cunninghame'[cunninghame@gorge.net]; 'callie@ridolfi.com'['callie@ridolfi.com']; Conley, Alanna[conley.alanna@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; courtney@crag.org[courtney@crag.org]; ''Dan Hafley'[HAFLEY.Dan@deq.state.or.us]; ''Dana Bayuk'[bayuk.dana@deq.state.or.us]; Eric Blischke[blischkee@cdmsmith.com]; ''Gail Fricano'[gfricano@indecon.com]; ''Genevieve Angle'[Genevieve.Angle@noaa.gov]; Holly Partridge[Holly.Partridge@grandronde.org]; ''JD Williams'[jd@williamsjohnsonlaw.com]; ''Jen Kassakian'[jkassakian@indecon.com]; 'Jeremy_Buck@fws.gov'['Jeremy_Buck@fws.gov']; ''Julie Weis'[jweis@hk-law.com]; ''Keith Johnson'[johnson.keith@deq.state.or.us]; Koch, Kristine[Koch.Kristine@epa.gov]; 'Kristin Callahan'[kristin@ridolfi.com]; ''Lance Peterson'[PetersonLE@cdmsmith.com]; ''Matt Johnson'[matt@williamsjohnsonlaw.com]; ''Matt McClincy'[mcclincy.matt@deq.state.or.us]; 'Michael.karnosh@grandronde.org'['Michael.karnosh@grandronde.org']; nancy.munn@noaa.gov[nancy.munn@noaa.gov]; 'peterson.Jennifer@deq.state.or.us'['peterson.Jennifer@deq.state.or.us']; 'poulsen.mike@deq.state.or.us'['poulsen.mike@deq.state.or.us']; ''Rachel DelVecchio'[rdelvecchio@indecon.com]; 'Robert.Neely@noaa.gov'['Robert.Neely@noaa.gov']; 'rose@yakamafish-nsn.gov'['rose@yakamafish-nsn.gov']; 'schwarz.bob@deq.state.or.us'['schwarz.bob@deq.state.or.us']; ''Ted Buerger'[ted_buerger@fws.gov]; 'tomd@ctsi.nsn.us'['tomd@ctsi.nsn.us']; 'tosm@yakamafish-nsn.gov'['tosm@yakamafish-nsn.gov']
From: Wetzsteon, Jackie
Sent: Fri 7/31/2015 11:54:26 PM
Subject: Transmittal of the Draft Implementability Study Report for River Mile 11E

Hi Sean – On behalf of the River Mile 11E Group, I am transmitting the draft Implementability Study Report for the River Mile 11E Project Area via the Hightail link below. Two hard copies of the report are being sent to DEQ.

Do not hesitate to call me if you have any questions. We look forward to discussing the report with you and your team.

Hope you have a great weekend,

Jackie

Jackie Wetzsteon

PacifiCorp

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A file has been sent to you via **Hightail**.
Download the file - RM11E ISR Draft Final 7-31-15.pdf
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Nancy Case O'Bourke, PE

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To: David Livermore (dlivermore@integral-corp.com)[dlivermore@integral-corp.com]; erik.ipsen@erm.com[erik.ipsen@erm.com]; karen.traeger@total.com[karen.traeger@total.com]; Stephen T. Parkinson - Arkema (SParkinson@jzplaw.com)[SParkinson@jzplaw.com]; todd.slater@total.com[todd.slater@total.com]
Cc: Zhen, Davis[Zhen.Davis@epa.gov]; Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; audiehuber@ctuir.com[audiehuber@ctuir.com]; bayuk.dana@deq.state.or.us[bayuk.dana@deq.state.or.us]; schwarz.bob@deq.state.or.us[schwarz.bob@deq.state.or.us]; bob@ridolfi.com[bob@ridolfi.com]; brandy.humphreys@grandronde.org[brandy.humphreys@grandronde.org]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; coffeyse@cdm.com[coffeyse@cdm.com]; Conley, Alanna[conley.alanna@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Courtney Johnson (courtney@crag.org)[courtney@crag.org]; cunninghame@gorge.net[cunninghame@gorge.net]; Dan Hafley (HAFLEY.Dan@deq.state.or.us)[HAFLEY.Dan@deq.state.or.us]; Charters, David[Charters.DavidW@epa.gov]; Fuentes, Rene[fuentes.rene@epa.gov]; Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle - NOAA-NMFS (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; jd@williamsjohnsonlaw.com[jd@williamsjohnsonlaw.com]; Jen Kassakian (jkassakian@indecon.com)[jkassakian@indecon.com]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; johnson.keith@deq.state.or.us[johnson.keith@deq.state.or.us]; jweis@hk-law.com[jweis@hk-law.com]; KingTW@cdmsmith.com[KingTW@cdmsmith.com]; Kristin Callahan[kristin@ridolfi.com]; Koch, Kristine[Koch.Kristine@epa.gov]; Lance Peterson (PetersonLE@cdmsmith.com)[PetersonLE@cdmsmith.com]; mcclincy.matt@deq.state.or.us[mcclincy.matt@deq.state.or.us]; tosm@yakamafish-nsn.gov[tosm@yakamafish-nsn.gov]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; nancy.munn@noaa.gov[nancy.munn@noaa.gov]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Rachel DelVecchio (rdelvecchio@indecon.com)[rdelvecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; ROICK.Tom@deq.state.or.us[ROICK.Tom@deq.state.or.us]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; ted_buerger@fws.gov[ted_buerger@fws.gov]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]
From: Sheldrake, Sean
Sent: Mon 7/27/2015 7:26:25 PM
Subject: Arkema work plan letter
Arkema Draft Sediment SF 7 27 15.pdf

Todd, David,

Please see the attached letter from Rick Albright with respect to our ongoing discussions on the Arkema data gathering effort. Please let me know whether LSS is interested in pursuing the extension versus AOC termination and we will proceed accordingly.

Thank you.

S

Sean Sheldrake, Unit Diving Officer, RPM

EPA Region 10, 1200 Sixth Ave., Suite 900; Mailstop DOC-01

Seattle, WA 98101

206.553.1220 desk

206.225.6528 cell

http://yosemite.epa.gov/r10/cleanup.nsf/sites/ptldharbor

http://www.epa.gov/region10/dive/

206.553.6379 Dive Operations Center

206.369.7500 Dive Unit cell

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

JUL 27 2015

OFFICE OF
ENVIRONMENTAL CLEANUP

Mr. Todd Slater
Legacy Site Services, LLC
468 Thomas Jones Way
Exton, Pennsylvania 19341

RE: Draft Sediment Sampling Work Plan, Arkema Inc. Portland Facility, U.S. EPA Region 10, Docket No. CERCLA 10-2005-0191 (June 27, 2005)

Dear Mr. Slater:

My dispute decision dated December 15, 2014 regarding Legacy Site Services, LLC (LSS) April 30, 2014 Draft Sediment Sampling Work Plan (work plan) provided a deadline of July 31, 2015 for EPA to approve or disapprove a sampling plan that was consistent with the decision. I'm writing to provide an extension to that deadline if LSS wishes to continue to work through issues to get to an approvable work plan.

Sean Sheldrake has informed me that the EPA and LSS met on April 7, 2015 to discuss EPA's February 12, 2015 comments on the work plan. Based on that meeting, LSS agreed to develop a series of memorandums providing supplemental information on three technical topics: Non-aqueous phase liquid (NAPL) evaluation, benthic risk evaluation and passive porewater sampling. EPA provided formal comments on the NAPL and passive sampling memorandums on May 19th and June 28th, 2015, respectively. In addition, teleconferences were held between EPA and LSS on May 26th and June 11th, 2015 to discuss the benthic risk memorandum and a teleconference was held on July 1, 2015 to discuss the passive sampling memorandum.

Given the steady progress described above, it appears likely that an approvable work plan could happen if more time is provided to work through remaining technical issues. I am willing to extend the deadline for EPA to approve a work plan to March 30, 2016. Should the work plan be approved, this revised date will allow for work plan implementation during the 2016 field season. The current Portland Harbor schedule calls for finalizing the Feasibility Study by the end of 2015 and completing the Proposed Plan in 2016. Based on this schedule, information gathered from work plan implementation will still serve its intended purpose of supporting pre-remedial design or remedial design for the Arkema site.

If LSS does not wish to continue to work through the remaining issues to get to an approvable work plan beyond the July 31 deadline, please notify Sean Sheldrake and EPA and LSS can proceed to terminate the Removal Action AOC per the March 31, 2014 letter from Mr. Parkinson.

Sincerely,

Richard Albright, Director
Office of Environmental Cleanup

cc: Sean Sheldrake, EPA
Matt McClincy, ODEQ
Lori Cora, EPA

To: Koch, Kristine[Koch.Kristine@epa.gov]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; DeMaria, Eva[DeMaria.Eva@epa.gov]; Conley, Alanna[conley.alanna@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Grandinetti, Cami[Grandinetti.Cami@epa.gov]; Zhen, Davis[Zhen.Davis@epa.gov]; Fleming, Sheila[fleming.sheila@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Kevin Parrett (parrett.kevin@deq.state.or.us)[parrett.kevin@deq.state.or.us]; Tom Roick (ROICK.Tom@deq.state.or.us)[ROICK.Tom@deq.state.or.us]; DECONCINI Nina[DECONCINI.Nina@deq.state.or.us]; Ells, Steve[Ells.Steve@epa.gov]; Charters, David[Charters.DavidW@epa.gov]; gilles.bruce@deq.state.or.us[gilles.bruce@deq.state.or.us]; Keith Johnson (johnson.keith@deq.state.or.us)[johnson.keith@deq.state.or.us]
Cc: Bill Ross (bross@rossstrategic.com)[bross@rossstrategic.com]; Townsend, Tom[Townsend.Tom@epa.gov]; Poland, Melody[Poland.Melody@epa.gov]; MEADOR Minnette (Meador.Minnette@deq.state.or.us)[Meador.Minnette@deq.state.or.us]
From: Robinson, Deborah
Sent: Wed 6/17/2015 1:16:12 AM
Subject: Latest agenda and handout for June 17, 2015 EPA/DEQ Staff/Managers Meeting in OOO
2015 6 17 Handout EPA-DEQ Staff-Mgt as of 6-16-15.docx
2015 6 17 Draft Agenda EPA-DEQ Staff-Mgt as of 6-16-15 for review.docx

Dear All,

Attached is the most recently revised agenda as well as a handout for the 6/17/15 meeting.

Call in number and url are included on the agenda.

Both documents are also attached to the meeting invitation.

Thanks,

Debbie

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From the Desk of:
Debbie Robinson
Tel: 206-553-4961
robinson.deborah@epa.gov

US EPA Region 10, M/S ECL 122, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101

From: Robinson, Deborah
Sent: Tuesday, June 16, 2015 3:14 PM
To: Koch, Kristine; Allen, Elizabeth; Sheldrake, Sean; Christopher, Anne; DeMaria, Eva; Conley, Alanna; Cora, Lori; Grandinetti, Cami; Zhen, Davis; Fleming, Sheila; Fonseca, Silvina; Legare, Amy; Ammon, Doug; Stalcup, Dana; Matt McClincy (mcclincy.matt@deq.state.or.us); Kevin

Parrett (parrett.kevin@deq.state.or.us); Tom Roick (ROICK.Tom@deq.state.or.us); DECONCINI Nina; Ells, Steve; Charters, David; gilles.bruce@deq.state.or.us; Keith Johnson (johnson.keith@deq.state.or.us)
Cc: Bill Ross (bross@rossstrategic.com); Townsend, Tom; Poland, Melody; MEADOR Minnette (Meador.Minnette@deq.state.or.us)
Subject: Draft agenda for June 17, 2015 EPA/DEQ Staff/Managers Meeting in OOO

Dear All,

Attached is the current draft agenda for tomorrow's EPA/DEQ Staff/Managers Meeting. For those of you who have looked at drafts, there are some changes. There may be additional small changes by the time we meet tomorrow. Please forward this to anyone I may have missed.

We will meet at 1:00 pm in the EPA Oregon Operations Office.

The call-in information and url are on the agenda.

Thanks,

Debbie

===================================
From the Desk of:
Debbie Robinson
Tel: 206-553-4961
robinson.deborah@epa.gov

US EPA Region 10, M/S ECL 122, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101

To: Cohen, Lori[Cohen.Lori@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Grandinetti, Cami[Grandinetti.Cami@epa.gov]; Yamamoto, Deb[Yamamoto.Deb@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Conley, Alanna[conley.alanna@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; DECONCINI.Nina@deq.state.or.us[DECONCINI.Nina@deq.state.or.us]; JOHNSON.Keith@deq.state.or.us[JOHNSON.Keith@deq.state.or.us]; PARRET.Kevin@deq.state.or.us[PARRET.Kevin@deq.state.or.us]; gilles.bruce@deq.state.or.us[gilles.bruce@deq.state.or.us]; GAINER.Tom@deq.state.or.us[GAINER.Tom@deq.state.or.us]; MCCLINCY.Matt@deq.state.or.us[MCCLINCY.Matt@deq.state.or.us]; LIVERMAN.Alex@deq.state.or.us[LIVERMAN.Alex@deq.state.or.us]; Bill Ross (bross@rossstrategic.com)[bross@rossstrategic.com]
From: Robinson, Deborah
Sent: Wed 3/4/2015 2:39:06 AM
Subject: Draft Agenda Outline - 3/13/15 DEQ/EPA Meeting
2015 3-11 Draft Participants Agenda rev 3-3-15.docx

Dear All,

Attached is a draft agenda outline for the DEQ/EPA Monthly meeting scheduled Wednesday March 11, 1:00 pm – 3:30 pm Pacific.

Below is a list of recipients of this email. If I missed someone, please forward it. Dana and Doug, I only included the two of you, so please distribute this to the appropriate people at HQ.

This agenda will evolve. Bill Ross will meet with several parties and make changes. Also, please review the agenda and let Tom Gainer and/or me know of any changes you suggest, or any particular topic you want to emphasize.

People listed as "Lead" for a topic will receive more information about what should be covered during your portion of the meeting.

Thank you,

Debbie Robinson

Recipients in EPA R10:

Lori Cohen
Cami Grandinetti
Deb Yamamoto
Kristine Koch
Sean Sheldrake
Rich Muza
Anne Christopher
Debbie Robinson
Elizabeth Allen
Alanna Conley
Lori Cora

Recipients in EPA HQ:

Ammon

Stalcup

Recipients in DEQ:

DECONCINI.Nina@deq.state.or.us

JOHNSON.Keith@deq.state.or.us

PARRET.Kevin@deq.state.or.us

GILLES.Bruce@deq.state.or.us

GAINER.Tom@deq.state.or.us

MCCLINCY.Matt@deq.state.or.us

LIVERMAN.Alex@deq.state.or.us

Consultant:

Bill Ross

===================================

From the Desk of:
Debbie Robinson
US EPA Region 10, M/S OMP-211, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101
Tel: 206-553-4961
robinson.deborah@epa.gov

DEQ/EPA Monthly Meeting
March 11, 2105
Conference Room, EPA Oregon Operations Office
805 SW Broadway, Suite 500, Portland, OR
1:00 pm – 3:00 pm Staff and Managers
3:00 – 3:30 pm Managers Only

Facilitated by Bill Ross, Ross Strategic

Purpose:

- In general, enable EPA and DEQ track what EPA and DEQ are doing the impacts of each agency's actions and decisions. Facilitate vertical integration.
- Discuss and resolve problems.

Time	***Topics***	***Lead***
5 min	Open, Agenda Review	Bill
15 min.	What's going on and what's coming up? • RI/FS • Source Control	Kristine Keith
50 min.	Recontamination - DEQ Present Recontamination Framework • Relationship of PRGs to recontamination and source control	Matt
15 min.	Roles and Responsibilities for in-water roll-out to partners – Willamette Cove and River Mile 11E	Cami and Keith
20 min.	EPA describe roles and responsibilities for PH staff	Lori/Cami
5 min.	Review Next Steps, Topics for next meeting, Close	Bill
30 min.	Managers Only	Bill

Topics for future meetings

	Issues related to Conceptual Remedy – flesh out what will happen around Conceptual Remedy and Review Board	Ammon Cami

To: (Jackie.Wetzsteon@pacificorp.com)[Jackie.Wetzsteon@pacificorp.com]; Bill Ford (WFord@LATHROPGAGE.COM)[WFord@LATHROPGAGE.COM]; Dave Livesay[DLivesay@gsiws.com]; Erin Carroll Hughes[EcHughes@gsiws.com]; Jeff Groy (Jeff.Groy@cbs.com)[Jeff.Groy@cbs.com]; Kim Cox (Kim.Cox@portlandoregon.gov)[Kim.Cox@portlandoregon.gov]; Matt Wells (wells@tmw-law.com)[wells@tmw-law.com]; Nanci Klinger (N.Klinger@portlandoregon.gov)[N.Klinger@portlandoregon.gov]; Paul Fuglevand[pfuglevand@dofnw.com]
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From: Sheldrake, Sean
Sent: Wed 4/1/2015 3:32:28 PM
Subject: FW: Update on Schedule for Submission of the Draft Porewater Characterization Report
Request for Extension on Porewater Characterization Report 3 31 15 SF.pdf

Jackie,

Thank you for the attached request. Your request is approved; let me know if you have any questions or concerns.

S

Sean Sheldrake, Unit Diving Officer, RPM

EPA Region 10, 1200 Sixth Ave., Suite 900; Mailstop DOC-01

Seattle, WA 98101

206.553.1220 desk

206.225.6528 cell

http://yosemite.epa.gov/r10/cleanup.nsf/sites/ptldharbor

http://www.epa.gov/region10/dive/

Like us on Facebook! https://www.facebook.com/EPADivers

From: Wetzsteon, Jackie [mailto:Jackie.Wetzsteon@pacificorp.com]
Sent: Tuesday, March 31, 2015 3:13 PM
To: undisclosed-recipients
Subject: Update on Schedule for Submission of the Draft Porewater Characterization Report

Hi Sean,

Attached is a request for an extension to the deadline for the submission of the draft Porewater Characterization Report from April 30, 2015 to May 21, 2015 due to the delay in the receipt of analytical results from ALS Environmental.

Call me if you have questions,

Jackie

Jackie Wetzsteon

PacifiCorp

Strategic Policy and Environment

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Portland, OR 97232

(503) 813 5036 (work)

(503) 961 3955 (cell)

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A MIDAMERICAN ENERGY HOLDINGS COMPANY

825 NE Multnomah, 1500 LCT
Portland, OR 97232
phone (503) 813-5036

March 31, 2015

Via E-Mail

Sean Sheldrake
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
M/S ECL-115
Seattle, WA 98101
Sheldrake.sean@epa.gov

Re: Supplemental RI/FS Work at the River Mile 11E Project Area
Portland Harbor Superfund Site (PHSS)
Request for Extension on the Draft Porewater Characterization Report Deliverable

Dear Mr. Sheldrake:

As a follow-up to our letter dated January 16, 2015 (attached), the RM11E Group is providing you with an update on the status of the porewater data and report deliverable. As noted in the February 2015 monthly report, ALS Environmental was late in getting the unvalidated data to the RM11E Group and we did not receive the completed unvalidated data packages until March 11, 2015. This is three and a half weeks after the anticipated February 14, 2015 date that was mentioned in the attached letter.

To accommodate the delay in the receipt of the unvalidated data and allow enough time for third party data validation and preparation of a quality work product, the RM11E Group is requesting a three week schedule extension on the Draft Porewater Characterization Report. The draft report will be submitted to EPA by Thursday May 21, 2015.

Please do not hesitate to contact me if you have any questions or concerns.

Sincerely yours,

Jacqueline Thiell Wetzsteon
RM11E Project Coordinator

Enclosure

Cc (via email):
River Mile 11E Respondents
AOC Notice Recipients (Paragraph 97.c through m)
Paul Fuglevand

PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

825 NE Multnomah, 1500 LCT
Portland, OR 97232

phone (503) 813-5036

January 16, 2015

Via E-Mail

Sean Sheldrake
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
M/S ECL-115
Seattle, WA 98101
Sheldrake.sean@epa.gov

Re: Supplemental RI/FS Work at the River Mile 11E Project Area
Portland Harbor Superfund Site (PHSS)
Update on the Status of the Porewater Data and Report Deliverable Schedule

Dear Mr. Sheldrake:

Thank you for meeting with us on January 8, 2015 to discuss the screening process for identifying Recontamination Potential Contaminants. As we discussed during our meeting, the River Mile 11E (RM11E) Group contractors identified significant issues with the validity of data from the polyethylene (PE) and sediment samples analyzed by ALS Environmental (ALS) as part of the RM11E porewater characterization effort. As described in the attached letter from ALS, the laboratory thoroughly reviewed the data and identified laboratory procedures that led to the data issues. In light of these issues, ALS developed a plan for corrective action for re-analysis of the data, and recalled the PE and sediment data packages. ALS is re-extracting and re-analyzing the PE and sediment samples. As outlined in the attached letter, ALS plans to complete the re-analysis of the data by February 14, 2015. At that time, the data will be independently validated.

This data issue will necessarily cause a delay in the preparation of the Draft Porewater Characterization Report. The RM11E Group anticipates transmitting the Draft Porewater Characterization Report to EPA by April 30, 2015 (approximately 60 days after receipt of validated data). We propose keeping the delivery date of the Implementability Study as is, i.e., August 1, 2015. However, in order to accommodate the delay in preparation of the Porewater Characterization Report, and to more efficiently sequence the overall RM11E efforts, we propose de-coupling the due dates for the Implementability Study and Recontamination Assessment by adjusting the delivery date for the Recontamination Assessment by one month, making it due September 1, 2015.

An updated schedule of the remaining deliverables for the RM11E project is attached for your approval.

Please do not hesitate to contact me if you have any questions.

Sincerely yours,

Jacqueline Thiell Wetzsteon
RM11E Project Coordinator

Attachments:
Schedule of Remaining Project Deliverables for the RM11E Project Area
January 7, 2015 Letter from ALS Environmental re Data Recall

cc: River Mile 11E Respondents
AOC Notice Recipients (Paragraph 97.c through m)
Paul Fuglevand

ED_000959_Converted_PSTs_0009853 6-00003 01/24/2020 SEMS_0333914

Schedule of Remaining Project Deliverables for the RM11E Project Area

Activity	Work Product	Schedule
Porewater Characterization Report	Draft Porewater Report	Due to EPA Team: **April 30,2015**
	Final Porewater Report	Due to EPA Team: **30 days after receipt and resolution of EPA Team comments on the draft Porewater Characterization Report (anticipated by August 1, 2015)**
Implementability Study	Draft Implementability Report	Due to EPA Team: **August 1, 2015**
	Final Implementability Report	Due to EPA Team: **30 days after receipt and resolution of EPA Team comments on the draft Implementability Report**
Recontamination Evaluation	Draft Recontamination Assessment Report	Due to EPA Team: **September 1, 2015**
	Final Recontamination Assessment Report	Due to EPA Team: **30 days after receipt and resolution of EPA Team comments on the draft Recontamination Assessment Report**

Updated 1/16/15

1317 South 13th Avenue
Kelso, WA 98626
T: +1 360 577 7222
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www.alsglobal.com

January 7, 2015

Tim Thompson
Science and Engineering for the Envrironment, LLC
4401 Latona Ave NE
Seattle, WA 98105

Re: **Data Recall – River Mill 11 East: K1411748 & K1411753**

Dear Tim:

Please be advised that ALS Environmental (ALS) is voluntarily re-calling the data packages submitted for the River Mile 11 East (RM11E): K1411748 & K1411753. ALS acknowledges problems with those data that have been identified in subsequent discussions between SEE, GSI, Pyron Environmental, and our own internal staff here and in Houston. We now do not believe that these data meet the QA/QC requirements for the project, and as a result the sensible course of action is to reject these data and to re-extract and re-analyze the PE and the sediments.

I have summarized information related to the analysis of the samples for the RM11E project and the subsequent recall of the data initially released by ALS. Please note the following:

- **Background & Justification for Recall – Polyethylene Samples**
  - The problems associated with the PE data were threefold: (1) Method Blank contamination; (2) high analyte concentration relative to the concentration of the added internal standards.; and (3) co-extractable material from the PE (after retrieval from the field) became significant after concentrating to 20 uL and negatively impacted the performance of the HRMS instrument.
  - The impact of the combination of Method Blank contamination and relatively low internal standard concentrations was questionable results for the PRCs (particularly in the high level samples), and also created a number of qualifiers for some of the non-PRC congeners.
  - The data was qualified (narrated and flagged) and reported as analyzed, as the impact of the problems relative to the usability of the data were not thoroughly understood at the time of reporting. Note the values analyzed were excessively high as compared to normal levels typically observed when using EPA Method 1668x.
  - After a thorough review of the data by SEE, GSI, and Pyron Environmental, a number of anomalies indicated the results were most likely significantly impacted by the aforementioned problems.
  - Additional investigation was performed by ALS to better understand the potential source(s) of the problems. Specifically, the following items were identified:
    - The source of the Method Blank contamination was narrowed down to the extraction process, potentially coming from airborne PCBs during the concentration

step, as well as potential cross-contamination from non-disposable extraction equipment.
    - The high analyte concentration compared to the relatively low concentration of the added labeled internal standards did not allow for dilution of the extracts.
    - The "209 Congener" standard prescribed by the method to develop response factors for congeners without five-point calibrations was orders of magnitude lower than numerous target compounds.
    - The small final volume in conjunction with the non-target background required fairly aggressive cleanup of the extracts. Note that the non-target background was significantly more prevalent in the field samples than the initial t_o samples, where it was essentially non-existent.
    - Also of note was the fact that the laboratory was attempting to achieve reporting limits approximately 10-20x lower than required by the Sampling and Analysis Plan (SAP). This compounded the issue of the variability in concentrations of the target analytes (i.e. elevated levels versus trace levels).
  - As a result of the lack of usability and in consideration of the various issues surrounding the analysis and the impact on the passive sampling application, ALS Environmental took the initiative to recall the original report, implement modifications to the analytical procedure employed, and agreed to re-analyze archived PE samples.

- **Corrective Actions to be Implemented for Re-analysis – Polyethylene Samples**
  - Samples consisting of high PRC loading will be segregated from samples with low PRC loading during the entire analytical procedure to minimize cross-contamination.
  - Additional decontamination of common laboratory equipment will be implemented as a precautionary step in the process knowing these samples contain concentrations atypical of routine Method 1668x applications.
  - The labeled internal standards will be added at higher concentrations to allow subsequent dilutions as needed to bring high concentration analytes into a reasonable range of the "209 Congener" standard.
  - The "209 Congener" standard will essentially be analyzed at a higher concentration to better coincide with the high concentration analytes.
  - The extraction formulation will be adjusted to produce reporting limits in line with the requirements of the SAP rather than attempting to push the limits too low relative to analyte concentrations.

- **Timeline**
  - The re-analysis of the PE samples as described (above) is expected to be completed by 2/14. As data are available we will send those to SEE for a "quick review" to ensure we are on-track to meet project goals.

- **Background and Justification for Recall - Sediments**
  - The primary question arising from the sediment analysis was related to variability in results between ALS/Kelso (Aroclors only), ALS/Houston, and MIT. Although the lack of precision and/or consistency between the various splits might be related to heterogeneous distribution of PCBs in the sediment samples, a recall of the data was advised in an attempt to more clearly understand the issue.

ED_000959_Converted_PSTs_0009853
6-00006 01/24/2020 SEMS_0333914

- Secondary issues of Method Blank contamination and inability to dilute due to low concentration internal standards were also noted for the sediments. As with the PE samples, these were related to high concentration analytes in the presence of trace level analytes.

- **Corrective Actions to be Implemented for Re-analysis**
  - As with the PE samples, some Method Blank contamination was noted, although to a lesser degree than the PE samples. Similar precautionary steps will be implemented as per the PE samples.
  - The labeled internal standards will also be added at higher concentrations to assist with the issue of diluting for high concentration analytes.

- **Timeline**
  - The re-analysis of the sediment samples as described (above) is expected to be completed by 2/14. As data are available we will those to see for a “quick review” to ensure we are on-track to meet the project goals.

As we discussed, these re-extractions and re-analyses will be at ALS' expense.

Please contact me at (360) 501-3316 or jeff.christian@alsglobal.com if you have further questions or comments related to this information.

Sincerely,
ALS Group USA Corp dba ALS Environmental

Jeff Christian

Jeff Christian
Director of Operations - Western USA

To: Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Audie Huber (audiehuber@ctuir.com)[audiehuber@ctuir.com]; Blischke, Eric[blischkee@cdmsmith.com]; Brian Cunninghame (cunninghame@gorge.net)[cunninghame@gorge.net]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; Coffey, Scott[CoffeySE@cdmsmith.com]; Conley, Alanna[conley.alanna@epa.gov]; Courtney Johnson (courtney@crag.org)[courtney@crag.org]; Erin Madden (erin.madden@gmail.com)[erin.madden@gmail.com]; Fuentes, Rene[fuentes.rene@epa.gov]; Personal Privacy / Ex. 6 Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Hagerman, Paul[HagermanPR@cdmsmith.com]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; JD Williams (jd@williamsjohnsonlaw.com)[jd@williamsjohnsonlaw.com]; Jeanette Mullin (mullinjm@cdmsmith.com)[mullinjm@cdmsmith.com]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; Julie Weis (jweis@hk-law.com)[jweis@hk-law.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Kristin Callahan (kristin@ridolfi.com)[kristin@ridolfi.com]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Morrison, Kay[morrison.kay@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]; rdelvecchio@indecon.com DelVecchio[RDelVecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Shephard, Burt[Shephard.Burt@epa.gov]; Todd King (KingTW@cdmsmith.com)[KingTW@cdmsmith.com]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; Tom Gainer (gainer.tom@deq.state.or.us)[gainer.tom@deq.state.or.us]
Cc: Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Charters, David[Charters.DavidW@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]
From: Koch, Kristine
Sent: Fri 4/3/2015 9:18:37 PM
Subject: FW: Portland Harbor Draft Appendix P
2014-03-02_Appendix P_RLSO.DOCX
2014-03-23_Appendix P.DOC
5909a_Updated Benthic WOE with FPM LRM and PEC_RM 2 to 7_LSM_20140415.pdf
5909b_Updated Benthic WOE with FPM LRM and PEC_RM 7 to 12_LSM_20140415.pdf
Attachment_2_Comprehensive Benthic Approach_clean_2014_03_24.xlsx
Attachment_2_Comprehensive Benthic Approach_revised_2015_03_02.xlsx

All – here is the revisions to the development of the benthic risk layer from the LWG. We can discuss this in our meeting next Thursday.

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: Jen Woronets [mailto:jworonets@anchorqea.com]
Sent: Friday, April 03, 2015 2:12 PM
To: Koch, Kristine
Cc: Amanda Shellenberger; Bob Wyatt; Carl Stivers; Jen Woronets; Jim McKenna (jim.mckenna@verdantllc.com); King, Todd W.; Mullin, Jeanette; Patty Dost; Scott Coffey (coffeyse@cdmsmith.com); Sheldrake, Sean; johnt@windwardenv.com
Subject: Portland Harbor Draft Appendix P

Kristine,

The following email is provided on behalf of Jim.

Kristine,

Attached please find a clean copy and redline/strikeout version of the draft Appendix P revised to reflect EPA's April 4, 2014 direction on changes to the comprehensive benthic approach. John Toll and I are available if you have any questions or want to discuss this draft document. Please let us know if the revisions are acceptable to EPA. Thanks, Jim.

Please let us know if you have any questions.

Thank you,

Jen Woronets ☺

Anchor QEA, LLC

jworonets@anchorqea.com

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To: Allen, Elizabeth[allen.elizabeth@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; Mullin, Jeanette[MullinJM@cdmsmith.com]; Coffey, Scott[CoffeySE@cdmsmith.com]
From: Koch, Kristine
Sent: Sat 3/14/2015 3:09:17 PM
Subject: FW: HQ Comments on draft Section 2 of FS for PH
2015_02_23 Portland Harbor FS Section 2 ALL comments.docx

All – please review these comments from HQ for discussion this week. I have reviewed all the comments and most of them I agree with and will be easily resolved. There are a few that we need to discuss as a team before discussing with HQ. I think those will become apparent when you read the comments. I have set the meeting to discuss these with HQ for 3/23 (look for meeting invite).

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: Fonseca, Silvina
Sent: Friday, March 13, 2015 2:31 PM
To: Koch, Kristine
Cc: Legare, Amy; Ells, Steve; Charters, David; Ammon, Doug; Stalcup, Dana; Gustavson, Karl
Subject: HQ Comments on draft Section 2 of FS for PH

Kristine,

The attached file has a redline/strikeout version of the draft Section 2 of the FS for PH. This file contains all the consolidated comments from the individuals in HQs that reviewed the document. The following are the significant issues we have identified that should be addressed, and if needed discussed. The file has additional comments, including editorial comments.

1) Contaminants of Concern

Deliberative Process / Ex. 5

2) RAOs

•□□□□□□□□ Place holder - Per discussion with management we will provide additional comments next week.

3) PRGs (Text and tables)

Deliberative Process / Ex. 5

4) Monitored Natural Recovery

•□□□□□□□□ MNR should be considered and selected only if verified to be occurring. Recommend providing relevant information that can support considering MNR as a general response action and ultimately a remedial component.

5) Enhanced Monitored Natural Recovery

•□□□□□□□□ ENNR section needs to be carried through the rest of the discussion. Section 2.4.4 identifies it but it is not described in section 2.4.5.

6) Confined Aquatic Disposal (CAD)

Deliberative Process / Ex. 5

7) ARARs

•□□□□□□□□ Current table is vague. Please provide information regarding to the process of fully developing a more detailed ARARs table. Robin Anderson is available to further discuss to assist you in developing and further identifying ARARs.

8) Section 2.2.6

Deliberative Process / Ex. 5

We are available to discuss with you any of these comments and can schedule a call to go through them. Look through the comments and let us know how you would like to proceed in responding to the comments.

Thank you and we appreciate the opportunity to review the document and look forward to working with you to finalize this section.

Silvina Fonseca, Environmental Engineer
Office of Superfund Remediation and Technology Innovation

Phone #: 703-603-8799
Fax #: 703-603-9104

To: Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Audie Huber (audiehuber@ctuir.com)[audiehuber@ctuir.com]; Blischke, Eric[blischkee@cdmsmith.com]; Brian Cunninghame (cunninghame@gorge.net)[cunninghame@gorge.net]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; Coffey, Scott[CoffeySE@cdmsmith.com]; Conley, Alanna[conley.alanna@epa.gov]; Erin Madden (erin.madden@gmail.com)[erin.madden@gmail.com]; Fuentes, Rene[fuentes.rene@epa.gov]; Gabriel Moses (b) (6) Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Hagerman, Paul[HagermanPR@cdmsmith.com]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; JD Williams (jd@williamsjohnsonlaw.com)[jd@williamsjohnsonlaw.com]; Jeanette Mullin (mullinjm@cdmsmith.com)[mullinjm@cdmsmith.com]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; Julie Weis (jweis@hk-law.com)[jweis@hk-law.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Kristin Callahan (kristin@ridolfi.com)[kristin@ridolfi.com]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Morrison, Kay[morrison.kay@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]; rdelvecchio@indecon.com DelVecchio[RDelVecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Todd King (KingTW@cdmsmith.com)[KingTW@cdmsmith.com]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; Tom Gainer (gainer.tom@deq.state.or.us)[gainer.tom@deq.state.or.us]
Cc: Ells, Steve[Ells.Steve@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]
From: Koch, Kristine
Sent: Mon 3/9/2015 3:09:18 PM
Subject: FW: Dioxin/Furan core maps
AQ_DioxinFuranCores 3-6-2015.pdf

All – Here are maps showing the core locations of dioxin/furan data.

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: Jennifer Woronets [mailto:jworonets@anchorqea.com]

Sent: Friday, March 06, 2015 3:39 PM
To: Koch, Kristine
Cc: Jennifer Woronets; Amanda Shellenberger; Bob Wyatt; Carl Stivers; Jim McKenna (jim.mckenna@verdantllc.com); King, Todd W.; Mullin, Jeanette; Patty Dost; Scott Coffey (coffeyse@cdmsmith.com); Sheldrake, Sean
Subject: FW: Dioxin/Furan core maps

Kristine,

Please see below and attached.

Let us know if you have any questions.

Thank you,

Jen Woronets ☺

Anchor QEA, LLC

jworonets@anchorqea.com

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From: Amanda Shellenberger
Sent: Friday, March 06, 2015 3:19 PM
To: Jennifer Woronets
Subject: Dioxin/Furan core maps

Kristine –

One of the action items from the 2/12 meeting with EPA was for Anchor QEA to provide maps showing the cores with dioxin/furan data in the SDUs where dioxin/furans are listed as a Primary COC in the 3/27/2014 table provided by EPA. Maps are attached, and a count of cores in each SDU is listed below:

- RM5.5E – 7 cores
- RM7W – 49 cores

Amanda Shellenberger, P.E.

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LEGEND

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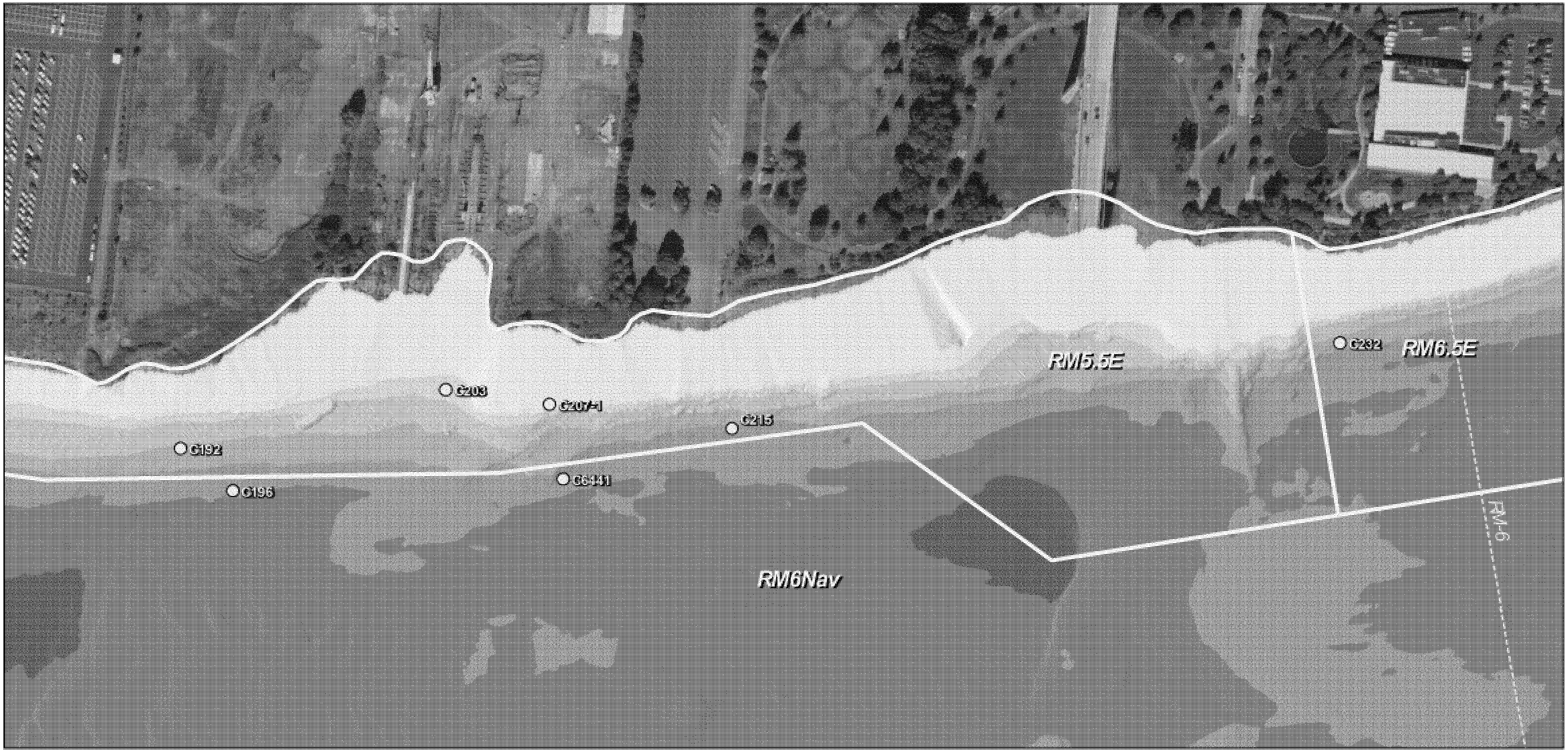
ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

Figure 1a
Portland Harbor RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM 5.5E



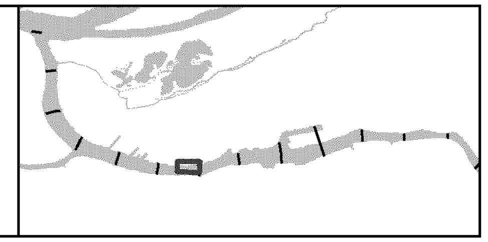
LEGEND

Core Locations
River miles
Navigation Channel

Bathymetry (ft, 2009)

-90.4 - -50	-29.9 - -20
-49.9 - -40	-19.9 - -10
-39.9 - -30	-9.9 - -5
	-4.9 - 40.5

Feet
0 90 180 270 360

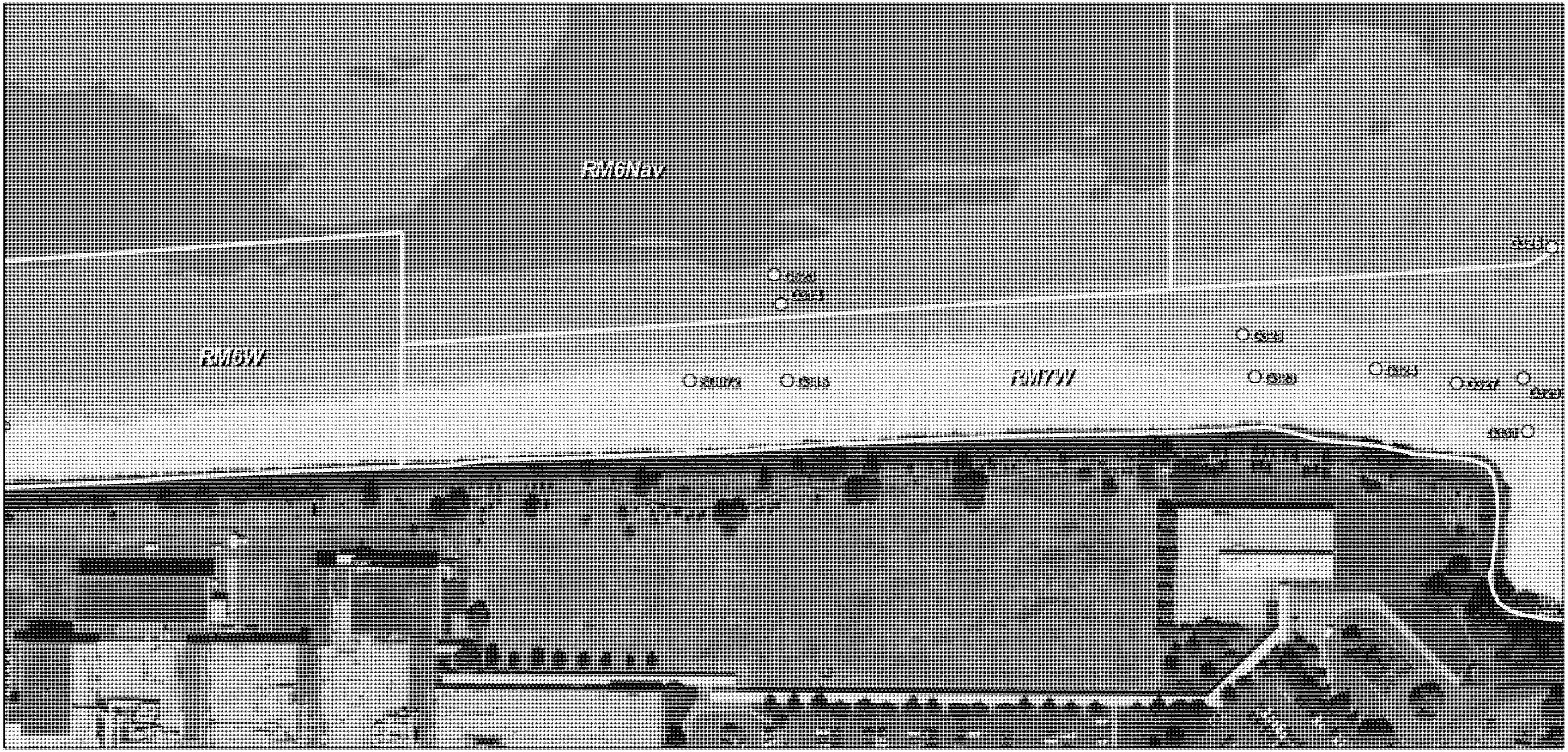


ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

Figure 1b
Portland Harbor RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM 5.5E

\\orcas\gis\Jobs\010142-01_AQ_LWG\Maps\postFS\requests\AQ_DioxinFuranCores.mxd eiverson 3/3/2015 11:32:07 AM



LEGEND

Core Locations
River miles
Navigation Channel

Bathymetry (ft, 2009)
-90.4 - -50
-49.9 - -40
-39.9 - -30
-29.9 - -20
-19.9 - -10
-9.9 - -5
-4.9 - 40.5

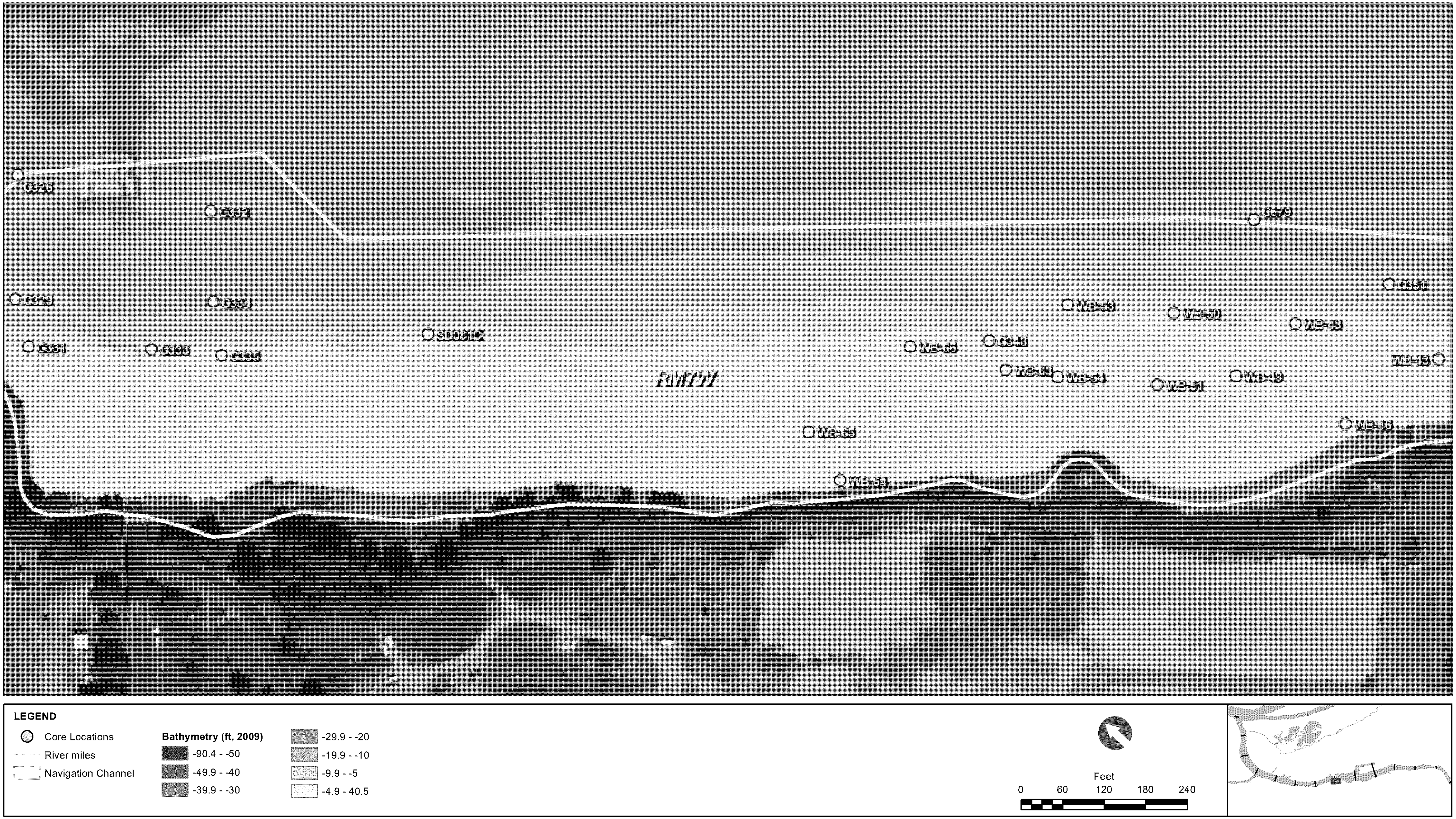
Feet
0 60 120 180 240

\\orcas\gis\Jobs\010142-01_AQ_LWG\Maps\postFS\requests\AQ_DioxinFuranCores.mxd eiverson 3/3/2015 11:32:23 AM

ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

Figure 2a
Portland Harbor RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM7W



ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

Figure 2b
Portland Harbor RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM7W

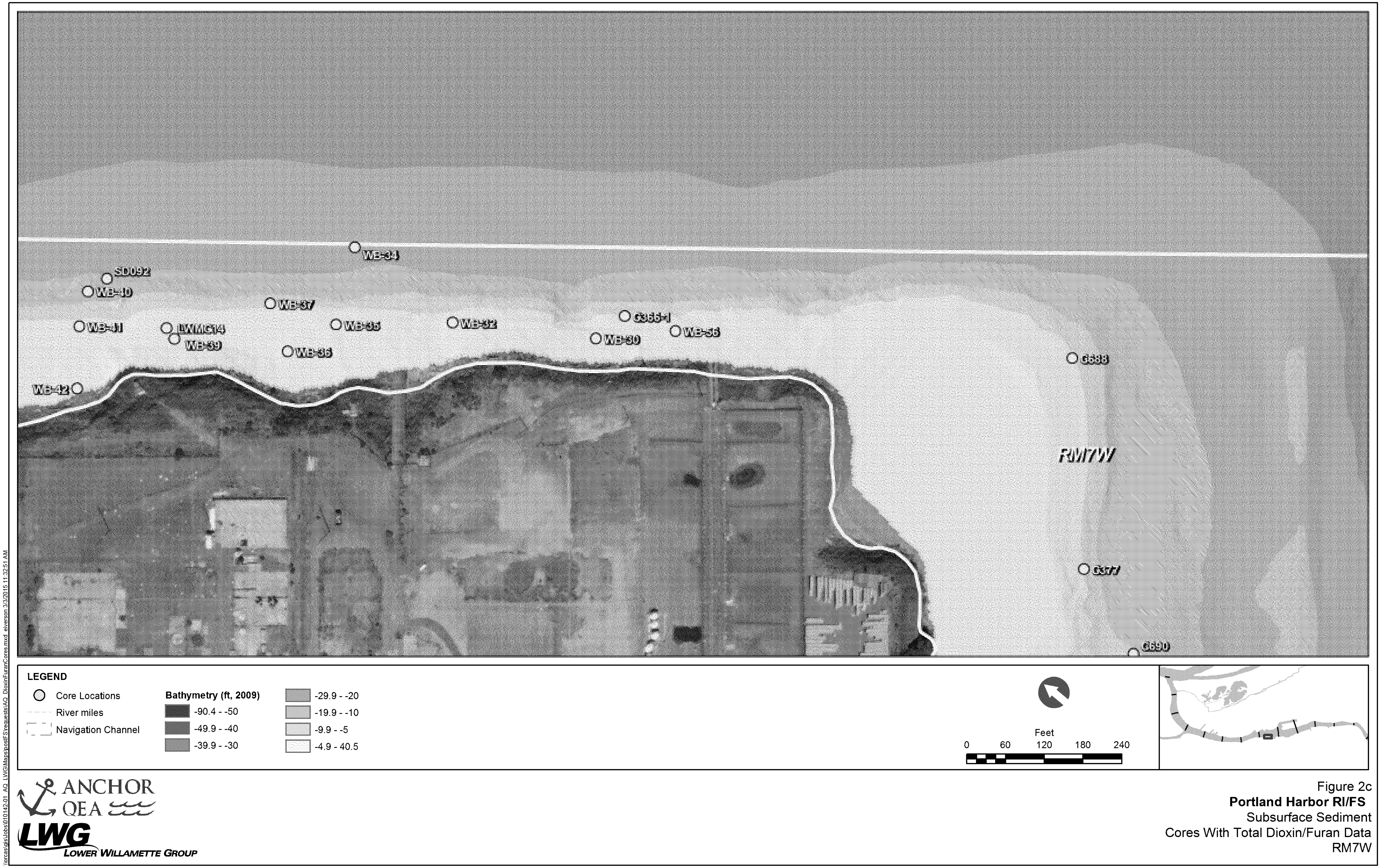


Figure 2c
Portland Harbor RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM7W

LEGEND

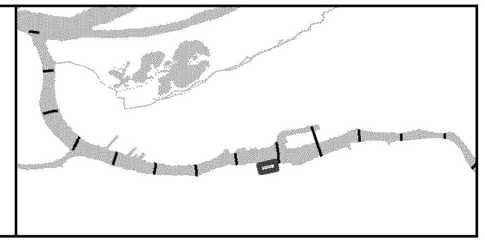
- Core Locations
- River miles
- Navigation Channel

Bathymetry (ft, 2009)

- -90.4 - -50
- -49.9 - -40
- -39.9 - -30
- -29.9 - -20
- -19.9 - -10
- -9.9 - -5
- -4.9 - 40.5

Feet

0 60 120 180 240



ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

Figure 2d
Portland Harbo r RI/FS
Subsurface Sediment
Cores With Total Dioxin/Furan Data
RM7W

\\orcas\gis\Jobs\010142-01_AQ_LWG\Maps\postFS\requests\AQ_DioxinFuranCores.mxd eiverson 3/3/2015 11:33:06 AM

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section lays the groundwork for developing a range of remedial action alternatives for the Portland Harbor Site. The information presented in this section identifies applicable, relevant, and appropriate requirements (ARARs); develops remedial action objectives (RAOs) that consider the contaminants and media of interest, exposure pathways and preliminary remediation goals; identifies general response actions (GRAs) focused on contaminated sediments and riverbanks; and screens remedial technologies and process options based on consideration of site-specific information.

The information presented in this section was developed consistent with EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988), EPA *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005), and EPA *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (USEPA 2002).

2.1 APPLICABLE, RELEVANT, AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA requires remedial actions to generally comply with all applicable or relevant and appropriate federal environmental or promulgated state environmental or facility siting laws, unless such standards are waived. "For the purposes of identification and notification of promulgated state standards, the term promulgated means that the standards are of general applicability and are legally enforceable" (NCP, 40 Code of Federal Regulations [CFR] 300.400[g][4]). CERCLA provides that a remedy that does not attain an ARAR can be selected if the remedy assures protection of human health and the environment and meets one of six waiver criteria described in Section 2.1.3.2.

"Applicable requirements" are defined in 40 CFR 300.5 as:

> *"those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."*

while "Relevant and appropriate requirements," are defined as:

> *"those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more*

stringent than federal requirements may be relevant and appropriate."

In addition to ARARs, advisories, criteria, or guidance may be identified as To Be Considered (TBC) for a particular release. As defined in 40 CFR 300.400(g)(3), the TBC category "consists of advisories, criteria, or guidance developed by the U.S. EPA, other federal agencies, or states that may be useful in developing CERCLA remedies." TBCs may be non-promulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs.

Under CERCLA 121(e), federal, state, or local permits need not be obtained for remedial actions which are conducted entirely on-site. "On-site" is defined as the "areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (40 CFR 300.5). Although a permit would not have to be obtained, the substantive (non-administrative) requirements of the permit must be met. Remedial activities performed off-site would require applicable permits.

2.1.1 Portland Harbor ARARs

Three categories of ARARs were identified for use in the FS:

- Chemical-specific requirements (**Table 2.1-1**)
- Location-specific requirements (**Table 2.1-2**)
- Performance, design, or other action-specific requirements (**Table 2.1-3**)

Chemical-Specific ARARs
Chemical-specific ARARs are usually health- or risk-based values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. If more than one such ARAR is available for a specific contaminant, alternatives should generally comply with the most stringent. Sediment, surface water, and groundwater have been identified as media of concern at the Site. Although there are no promulgated federal or Oregon ARARs providing numerical standards for contaminants in sediment, both federal and Oregon standards and criteria are available for surface water and groundwater. While Oregon does not have numeric sediment standards, Oregon has established acceptable risk levels for human and ecological receptors as described below.

In addition to Oregon WQS, CERCLA requires cleanups to achieve federal National Recommended Water Quality Criteria (NRWQC) developed to protect ecological receptors and human consumers of fish and shellfish if they are relevant and appropriate to the circumstances of the release of hazardous substances at the site [42 USC 9621(d)(2)(A)]. Specific Oregon WQS and federal NRWQC and other chemical-specific ARAR numeric values are provided in **Table 2.1-4**. In addition to numeric water quality criteria, Oregon narrative water quality criteria are potential ARARs that

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may get translated into numeric standards if needed or appropriate.

MCLs established under authority of the Safe Drinking Water Act (SDWA) are considered relevant and appropriate to groundwater and surface water at the Portland Harbor Site. National Secondary Maximum Contaminant Levels or Maximum Contaminant Level Goals (MCLGs), are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. Public drinking water systems in Oregon are subject to the Oregon Drinking Water Quality Act (ORS 448 – Water Systems). While the State of Oregon has exercised primary responsibility for administering the federal SDWA, in practice, the Oregon drinking water standards match the national standards.

Oregon Hazardous Substance Remedial Action Rules [OAR 340-122-0040(2)(a) and (c), 0115 (3),(32) and (51)] set standards for the degree of cleanup required and establish acceptable risk levels for humans and protection of ecological receptors at the individual level for threatened or endangered species and the population level for all others. It requires that hazardous substance remedial actions achieve one of three standards: a) acceptable residual risk levels as defined in OAR 340-122-0115 and as demonstrated by a residual risk assessment, b) numeric cleanup standards developed by ODEQ, or c) background levels in areas where hazardous substances occur naturally. Subsection (b) numeric cleanup standards relevant to the Portland Harbor cleanup have not been developed by ODEQ and therefore, is not an ARAR for this site.

Oregon Hazardous Substance Remedial Action Rules, OAR 340-122-0115, define the following acceptable risk levels relevant to the Portland Harbor site:[1]

- 1 in 1,000,000 (1 x 10^{-6}) lifetime excess cancer risk for individual carcinogens
- 1 in 100,000 (1 x 10^{-5}) cumulative lifetime excess cancer risk for multiple carcinogens
- A hazard index[2] (HI) of 1 for non-carcinogens
- For populations of ecological receptors, a 10 percent or less chance that more than 20 percent of the total local population will be exposed to an exposure point value greater than the ecological benchmark value for each COC and no other observed significant adverse effects on the health or viability of the local population
- For individuals of species listed as threatened or endangered, a toxicity index less than or equal to 1

[1] OAR 340-122-0115 also provides separate “acceptable risk levels” for probabilistic risk assessments for human health and for individual ecological receptors listed as threatened or endangered, which are not addressed in these bullets.

[2] An HI represents the sum of individual contaminant HQs

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While the target risk levels in the Oregon Rules for non-carcinogens and for the protection of ecological receptors are similar to those of the NCP, the Oregon Rules for individual and multiple carcinogens are more stringent than federal law and therefore are an ARAR.

Location-Specific ARARs
Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of specific locations include floodplains, wetlands, archaeological or cultural resources, historic places, the presence of threatened or endangered species and sensitive ecosystems or habitats. Executive Order 11988, 40 CFR 6.302 on Floodplain Management and the National Flood Insurance Act and Flood Disaster Protection Act, and 42 USC 4001 are location-specific ARARs for assuring that cleanup actions do not adversely impact existing flood storage capacity in the Willamette River floodplain. Likewise, the Federal Emergency Management Agency (FEMA) floodplain ARAR requires that any action that encroaches on the floodways of United States waters (such as sediment cleanup) cannot cause an increase in the water surface elevation of the river during a 100-year flood event.

Section 7 of the Endangered Species Act (ESA), 16 USC 1536(a)(2), requires that actions authorized by federal agencies may not jeopardize the continued existence of endangered or threatened species or destroy or adversely modify critical habitat. It is EPA policy to consult with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to ensure that actions are not likely to jeopardize the continued existence of any threatened or endangered species or result in adverse modification of species' critical habitat. If a jeopardy, or adverse modification opinion is issued by NMFS or USFWS, the opinion will include "reasonable and prudent alternatives" that are designed to allow the project to proceed in a manner that will not jeopardize the continued existence of the listed species, or adversely modify designated critical habitat. Five species of listed salmonids are known to use the Lower Willamette River as a rearing and migration corridor. Moreover, eight listed salmonid species, three additional listed fish species, and one listed mammal species are known to occur in the Lower Columbia River near the confluence with the Willamette River. A preliminary biological assessment will be developed for the proposed remedy to ensure that the proposed cleanup action is not likely to jeopardize the continued existence of any threatened or endangered species present at the site. Further consultation with NMFS and USFWS will be required prior to implementation of cleanup activities at the Portland Harbor Site.

Action-Specific ARARs
Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. These action-specific requirements do not in themselves determine the remedial alternative; they instead indicate how a selected alternative must be achieved. Some

federal and state requirements may be both location-specific and action-specific ARARs because they are invoked due to an action occurring on critical habitat or other special location, and they place limits or requirements on how such action is conducted.

Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged or fill material into navigable waters, with the exception of incidental fallback associated with dredged materials. This ARAR is applicable to cleanup actions in navigable waters of the Site that will discharge dredged material or capping material into the Willamette River or adjacent wetlands. A summary of the Section 404(b)(1) analysis of the proposed remedial alternative has been prepared (cite Appendix). The alternative evaluation process included considerations of the CWA hierarchy to avoid or minimize loss of aquatic habitat or function, but if a loss was deemed unavoidable, then mitigation was included. The final assessment of loss and determination of mitigation will be made during remedial design.

2.1.2 ARAR Waivers

If it is found that the most suitable remedial alternative does not meet an ARAR, the NCP provides for waivers of ARARs under certain circumstances. According to 40 CFR 300.430(f)(1)(ii)(C):

> *"An alternative that does not meet an ARAR under federal environmental or state environmental or facility siting laws may be selected under the following circumstances:*
>
> 1. *The alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate federal or state requirement;*
> 2. *Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;*
> 3. *Compliance with the requirement is technically impracticable from an engineering perspective;*
> 4. *The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach;*
> 5. *With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state; or*
> 6. *For Fund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund money to respond to*

other sites may present a threat to human health and the environment."

The basis for ARAR waivers, including technical impracticability, is presented in USEPA 1989a.

2.2 REMEDIAL ACTION OBJECTIVES

RAOs consist of media-specific goals for protecting human health and the environment. RAOs provide a general description of what the cleanup is expected to accomplish and help focus alternative development and evaluation.

RAOs specify:

- Contaminants of concern (COCs) for each media of interest;
- Exposure pathways, including exposure routes and receptors; and
- An acceptable contaminant concentration or range of concentrations for each exposure route.

The following general narrative RAOs have been developed for the Portland Harbor site:

Human Health

- **RAO 1 – Sediments:** Reduce cancer risk and noncancer hazards to people from incidental ingestion of and dermal contact with contaminated sediments and riverbank soils by reducing the concentrations of COCs in sediment at the site to the proposed remediation goals listed in **Table 2.2-1**, that are acceptable for subsistence, occupational, recreational, and ceremonial uses.
- **RAO 2 – Biota**: Reduce cancer risk and noncancer hazards for people eating fish and shellfish, and infants exposed being breastfed by mothers who consume fish from Portland Harbor by reducing the concentrations of COCs in sediments, riverbank soils, surface water, and biota at the site to the proposed remediation goals listed in **Table 2.2-1**.
- **RAO 3 – Surface Water:** Reduce cancer risk and noncancer hazards to people from direct contact (ingestion, inhalation, and dermal contact) with contaminants in surface water, and via consumption of fish and shellfish by reducing the concentrations of COCs in surface water at the site to the proposed remediation goals listed in **Table 2.2-1.** These goals are protective of use of the Willamette River as a potential drinking water source, as well as for human consumption of fish and shellfish caught in the Willamette River.

- **RAO 4** – **Groundwater:** Reduce migration of contaminants from groundwater to sediment and surface water to levels that are protective of human health in sediment, surface water, and biota (MCLs and AWQC). PRGs for this RAO will be measured in the pore water, and are listed in **Table 2.2-1**.

Ecological

- **RAO 5** – **Sediments:** Reduce risk to ecological receptors from ingestions of and direct contact with contaminated sediments and riverbank soils by reducing the concentrations of COCs in sediment at the site to the proposed remediation goals listed in **Table 2.2-1**.

- **RAO 6 – Biota (Prey):** Reduce risks to ecological receptors that consume contaminated prey by reducing the concentrations of COCs in sediments and biota at the site to the proposed remediation goals listed in **Table 2.2-1**.

- **RAO 7** – **Surface Water:** Reduce risks to ecological receptors from ingestion of and direct contact with contaminants in surface water by reducing the concentrations of COCs in surface water at the site to the proposed remediation goals listed in **Table 2.2-1**.

- **RAO 8** – **Groundwater:** Reduce migration of contaminants from groundwater to sediment and surface water to levels that are protective of ecological receptors in sediment, surface water, and biota (MCLs and AWQC). PRGs for this RAO will be measured in the pore water, and are listed in **Table 2.2-1**.

It is EPAs' expectations that the State's actions to address source control will adequately address groundwater contamination. Should groundwater not be addressed adequately under those actions, EPA may at a future time determine if action is warranted under CERCLA to address groundwater. The RAOs above relate to the action being conducted under CERCLA, and meeting the above objectives is dependent on the source control actions being conducted by ODEQ. In addition, an objective for addressing groundwater contamination is not included in this action as groundwater contamination is primarily due to the upland sources being addressed by the ODEQ source control actions.

In addition to the RAOs for protection of human health and ecological receptors, the following principles that will be considered for protection of human health and the environment for the Portland Harbor Site. Consistent with EPA guidance (USEPA 2005), upland and upstream source control efforts need to be designed to prevent recontamination via groundwater, stormwater, soil erosion, air deposition, and overwater activities, are consistent with the RAOs and sediment cleanup activities, and allow in-water remedies at the Site to proceed in a timely manner. To the maximum extent practicable, minimize the long-term transport of COCs from the Site to the

Columbia River and Multnomah Channel. Clean up contaminated sediments in a manner that promotes habitat that will support a healthy aquatic ecosystem and the conservation and recovery of threatened and endangered species. These principles will be evaluated in the FS to ensure a successful remedy and will require integration with other regulatory mechanisms to implement, such as State of Oregon Water Quality and Environmental Cleanup programs.

The following subsections discuss the development of PRGs for each RAO. The PRG selection process consists of the following steps:

1. Identify the COCs (Section 2.2.1).

2. Development of PRGs for the applicable exposure routes and receptors (Section 2.2.2).

2.2.1 Identification of Contaminants of Concern

EPA guidance defines COCs as a subset of the contaminants of potential concern[3] (COPCs) that are identified in the RI/FS as needing to be addressed by the response action proposed in the ROD (USEPA 1999). The baseline human health risk assessment (BHHRA, Kennedy/Jenks 2013) and baseline ecological risk assessment (BERA, Windward 2013) evaluated contaminants in sediments, surface water, biota, and groundwater in the Willamette River, and identified the pathways through which humans and ecological receptors could be exposed to those contaminants. Contaminants found to pose a lifetime cancer risk greater than 1×10^{-6} or hazard quotients (HQs) greater than 1 were identified as contaminants posing unacceptable risks.

Considerations for selecting COCs at Portland Harbor include the magnitude and confidence in the risk estimate, the distribution of contamination and the degree to which contaminants at the site are co-located, contaminant concentrations relative to chemical-specific ARARs, and the frequency at which risk-based PRGs or chemical-specific ARARs are exceeded. In some cases, contaminants were grouped based on chemical structure and toxicity. For example, individual PAHs were grouped as total carcinogenic PAHs (cPAHs), total PAHs, total low molecular weight PAHs (LPAHs), and total high molecular weight PAHs (HPAHs).

Table 2.2-2 presents the list of chemicals identified in the BHHRA and BERA as posing unacceptable risk, as well as the rational for selecting the COCs for the FS. The rationale for identifying COCs is described below.

Infrequent and/or Anomalous Detections
Antimony was eliminated as a COC because the unacceptable risk estimates were based on a single result in smallmouth bass. These results were considered to be unrepresentative as likely the result of a sinker in the gut being incorporated into the

[3] COPCs are defined as those contaminants potentially site-related and whose data are of sufficient quality for use in the quantitative risk assessment (USEPA 1989b).

chemical analysis rather than representative of true tissue concentrations.

Weak Lines of Evidence
A number of contaminants were eliminated as COCs because the estimated risk to ecological receptors was based on a weak line of evidence. These include 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 4-methylphenol, aluminum, ammonia, aniline, barium, benzyl alcohol, beryllium, chloroethane, cobalt, diazinon, dibutyl phthalate, diesel range organics, endrin, endrin ketone, heptachlor epoxide, iron, isopropylbenzene, magnesium, monobutyltin, nickel, phenol, potassium, sodium, TPH C4-C6 aliphatics, TPH C6-C8 aliphatics, and TPH C8-C10 aromatics.

Comparison to Background
Silver was eliminated as a COC because reported concentrations did not exceed naturally-occurring background concentrations anywhere at the site.

Co-location with Other Contaminants
Total endosulfan and sulfide were eliminated as COCs because the areas where they were detected were co-located with DDx and dioxins/furans in sediments offshore of the Arkema site, and with PAHs in sediments offshore of the Gasco site. Beta and delta-hexachlorocylohexane were eliminated as COCs because they are co-located with gamma-hexachlorocylohexane (Lindane).

Related Contaminants Addressed by Other Contaminants

- **Individual PAHs:** Although individual carcinogenic PAHs were identified as posing unacceptable risk the BHHRA, they will be evaluated in the FS as total cPAHs expressed as benzo(a)pyrene equivalents. Similarly, although naphthalene and benzo(a)pyrene were identified in the BERA posing unacceptable risk, they were not identified individually as COCs because they will be addressed by LPAHs and HPAHs, respectively.

- **Total DDD, DDE and DDT:** DDD, DDE, and DDT were grouped together for PRG development purposes because DDE and DDD are transformation products of DDT, and based on their similar toxicological endpoint. Thus, the individual sums of the concentrations of these chemicals were eliminated as COCs because they are represented by total DDx.

The COCs for Portland Harbor are presented in **Table 2.2-3** and have been grouped by RAO and media. For purposes of the FS, they have been classified into three categories: 1) risk-based COCs, 2) media-based COCs, and 3) source-based COCs. The table reflects the category for each COC selected for each RAO.

Risk-Based COCs
Risk-based COCs were identified as posing unacceptable risk to human health or the environment in a specific media based on the results of the baseline risk assessments. Risk-based human health COCs were identified in beach and in-water sediment (RAO 1), fish tissue (RAO 2), and surface water (RAO 3). Risk-based ecological COCs were identified in sediment (RAO 5 and RAO 6), surface water (RAO 6 and RAO 7), and pore water[4] (RAO 8). Risk-based COCs are denoted with an "R" in **Table 2.2-3**.

Media-Based COCs
Media-based COCs are contaminants detected in surface water and sediment, but pose unacceptable risk via contact with other media. This applies primarily to consumption of fish and shellfish by humans, and prey consumption pathways by ecological receptors, as both sediment and water contribute to contaminant concentrations in the diet. Thus, sediment and surface water PRGs are developed to be protective of all exposure routes, and apply to RAO 2 and RAO 6. Media-based COCs are denoted with an "M" in **Table 2.2-3**.

Source-Based COCs
Limited surface water and pore water sampling was conducted at Portland Harbor, and was not always conducted where there was a known surface water or groundwater contaminant source. Consequently, COCs that were identified for other pathways are of concern in the surface water and groundwater source pathways. Additionally, five COCs (2,4-D, 2,4,5-TP, PCE, 1,1,1-TCA, and vinyl chloride) were detected in upland media (storm water and groundwater) at concentrations that indicate the potential for risk to human health or the environment based on exceedances of Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and National or State of Oregon water quality criteria were designated as source-based COCs. These are denoted with an "S" in **Table 2.2-3**. However, rather than evaluating source-based COCs directly in the FS, EPA expects that contaminated groundwater will be addressed through upland source control measures implemented under ODEQ regulatory authority, remedial design, and long-term monitoring. However, since groundwater plumes may extend beyond the point of upland control and into the river, EPA considers these COCs for those areas and in determining protective measures for the river environment.

2.2.2 Development of Preliminary Remediation Goals

The preliminary remediation goals are developed on the basis of site-specific risk-related factors, chemical-specific ARARs, when available, and consideration of background concentrations. Risk-based PRGs were developed to address unacceptable human health and ecological risks identified in the BHHRA and BERA, consistent with the NCP [300.430(e)(2)(i)]. These PRGs represent concentrations in environmental media which are protective of both human and ecological receptors.

[4] For the purposes of this FS, pore water is defined as interstitial water of bulk sediment within the biologically active zone.

2.2.2.1 Human Health Risk-Based PRGs

The BHHRA evaluated exposures and associated risks and hazards based on a number of current and potential land uses. Specific receptors evaluated were dockside workers, in-water workers, transients, recreational beach users, tribal, recreational, and subsistence fishers, divers, people using surface water for domestic household purposes; and infants consuming breast milk from mothers are exposed to certain bioaccumulative contaminants via one or more of the completed exposure pathways. Risk-based PRGs were calculated using the reasonable maximum exposure assumptions from the BHHRA, consistent with the NCP. They were developed for COCs in sediment and biota tissue, assuming target cancer risk levels of 10^{-6} and 10^{-4}, and a target non-cancer hazard of 1, for each of the receptors evaluated in the BHHRA and using the methodology described in **Appendix B1**.

Risk-based PRGs were calculated based direct contact with beach and in-water sediment (RAO 1), as well to be protective of direct and indirect exposures though consumption of fish and shellfish (RAO 2). Risk-based PRGs protective of fish/shellfish consumption were not developed for arsenic, mercury, BEHP, and PDBEs because a relationship between tissue and sediment concentrations could not be determined. The risk-based PRGs for RAOs 1 and 2 represent the lowest value in each media (beach or in-water sediment, and fish/shellfish tissue) to be protective of all potential receptors. Since surface water contributes to the risk exposure for RAO 2, surface water PRGs for RAO 2 were selected as the State of Oregon ambient water quality criteria (AWQC) for protection of human health consumption of organisms (OAR 340-041-0033, Table 40) and are presented in **Tables 2.2-4** and **2.2-5**.

EPA regional screening levels (RSLs) for tap water (EPA 2014) were used as the risk-based PRGs for RAOs 3 and 4. These values are presented in **Tables 2.2-6 and 2.2-7**.

2.2.2.2 Ecological Risk-Based PRGs

Ecological risk-based PRGs were developed for sediment, surface water, and pore water to meet the objectives associated with RAOs 5 through 8. The ecological risk-based PRGs were selected from medium- and contaminant-specific toxicity reference values (TRVs) protective of ecological receptors and used in the BERA, the process is detailed in **Appendix B2**.

Risk-based PRGs in sediment were selected from TRV values presented in the BERA that are protective of ingestion and direct contact with sediments (RAO 5) and calculated for upper trophic level receptors based on consumption of prey (RAO 6). The lowest value for each media was selected as the risk-based PRG for ROAs 5 and 6 to be protective of all potential receptors. Since water contributes to the exposure to PCBs and dioxins/furans for RAO 6, water TRVs in Attachment 10, Table 2 of the BERA were used for RAO 6. Water TRV values from Attachment 10, Table 2 in the BERA that are protective of ecological receptors were selected as risk-based PRGs for RAOs 7 and 8. The risk-based PRGs selected for RAOs 5 through 8 are presented in

Tables 2.2-8 through **2.2-11**.

In addition to the numerical TRVs, the BERA identified acceptable thresholds of risk for benthic macroinvertebrates exposed to contaminated sediments through the completion of sediment toxicity tests conducted at 256 stations throughout the Study Area. The sediment toxicity test based risk-based PRGs are expressed as the minimum percent survival or the minimum percent biomass reduction relative to survival or biomass in the laboratory negative control sediment response. Development of ecological PRGs for benthic risk is discussed in Appendix B2.

2.2.3 PRGs Based on Chemical Specific ARARs

Chemical specific ARARs were discussed in Section 2.1.1. The PRGs for RAOs 3 and 4 were selected from the State of Oregon AWQCs (organism + water) and MCLs presented in **Table 2.1-4**. The lower of the values identified for a particular contaminant was selected as the ARAR-based PRG. These values are presented in **Tables 2.2-6 and 2.2-7**. The PRGs for RAO 7 was selected from the State of Oregon AWQC (chronic aquatic life) presented in **Table 2.1-4**. These values are presented in in **Table 2.2-10**.

2.2.4 PRGs Based on Background Concentrations

Where CERCLA sites have non-site related sources of contaminant concentrations, an understanding of background conditions may be important for the purpose of developing and evaluating remedial action alternatives. Background concentrations may be used to develop remedial goals when risk-based PRG concentrations are less than naturally-occurring or anthropogenic background (USEPA 2002). The derivation of background concentrations in sediment for the Portland Harbor Site is described in Section 7 of the RI Report and are presented in **Tables 2.2-4, 2.2-5, 2.2-8 and 2.2-9**.

2.2.5 Selection of Preliminary Remediation Goals

PRGs for Portland Harbor are developed from site-specific risk-based PRGs, chemical-specific ARARs (when available), and consideration of background concentrations. The risk-based PRGs are compared to the chemical-specific ARARs, and the lower of the two value was then compared to background. Where both the risk-based PRGs and chemical-specific ARAR are less than the background concentration, the latter is selected as the final PRG. This process and the selected PRGs for each RAO are presented in **Tables 2.2-4** through **2.2-11**. **Table 2.2-1** provides a summary of the selected PRGs for all RAOs and the basis for each PRG is presented in **Table 2.2-14**.

2.2.6 Identification and Selection of Potential Target Areas and Volume Estimate for Remediation

When developing remedial alternatives, it is necessary to identify the sediments that should be targeted for remediation to meet the RAOs. Criteria for making this identification typically include identifying areas exceeding PRGs, as well as geochemical and statistical interpretations of contaminant concentration data and sediment characteristics. These analyses are described in detail in Section 3 of the RI Report and are summarized below.

The river's cross-sectional area increases steadily from RM 12 to RM 9. In this area, a change in sediment texture is also observed (**Figure 2.2-1**). The river bed upstream of RM 11.8 is predominantly coarser sediments with smaller areas of silt, often located outside the channel. The Study Area (below RM 11.8) becomes dominated by fine-grained material (silts) bank-to-bank, with pockets of coarser material (sand and gravel). At RM 8, the river narrows and the sediments become dominated by coarser material until about RM 5 where the river cross-sectional area increases and finer grain material again dominates the sediment. Approximately 85 percent of the surface sediments in the Study Area and, about 90 percent of the volume is comprised of ine-grained materials (silts). The federally-authorized navigation channel encompasses approximately 60 percent of the riverbed within the Study Area. Due to a combination of a wider cross-section and a deeper federally-authorized navigation channel below RM 11.8 (40 to 43 feet) than above RM 11.8, thicker and wider beds of contaminated sediments accumulated below RM 11.8 than above.

Analysis of surface sediment contamination (including BEHP, hexachlorobenzene, PBDEs and other compounds representing the classes of PCBs, dioxins/furans, pesticides, PAHs and metals) 23 resulted in a series of observations that form the basis for much of the CSM. Most of the contaminants examined, in studies conducted between 1995 and 2010, exhibited a broad range of concentrations (spanning an order of magnitude or more) within a given river mile interval between RM 1.9 to RM 11.8, with obvious areas of elevated concentrations at the point of release and decreasing concentrations moving downstream. More importantly, trends of the median concentration with river mile are evident (see **Tables 5.2-3, 5.2-5** and **5.2-7** in the Final RI Report). In the Study Area, the majority of the contamination is located in the nearshore areas. Some river miles are contaminated with only a few contaminants while others are contaminated with multiple contaminants. Some contaminants are found site-wide (PCBs, metals) while others are found in only portions of the Study Area (PAHs, DDx, dioxins/furans). In many cases, the subsurface concentrations in the river are significantly higher than those measured in surface sediments. This indicates that the majority of the source of the continuing sediment contamination must be in the river itself within the Study Area and to a lesser degree from lateral sources and the area upstream of the Study Area.

The area and volume of the sediments targeted for remediation in the Study Area (RM 1.9 to RM 11.8) are approximately 2,450 acres (essentially the entire Study Area) and 39 million cy, respectively (**Figure 2.2-2**). Ecological risk is only 64 percent of this area (1,560 acres). Concentrations of COCs within the Study Area are summarized in **Tables 2.2-15** and **2.2-16** for surface and subsurface sediment, respectively. Based on this information, the entire (bank-to-bank) river area from RM 1.9 to RM11.3 was selected for remediation because it contains COC concentrations in surface sediment bank-to-bank that exceed PRGs for at least one contaminant with even higher concentrations of each contaminant at depth.

2.3 GENERAL RESPONSE ACTIONS

This section identifies the general response actions for the remedial alternatives evaluated in this FS. General Response Actions (GRAs) are major categories of media-specific cleanup activities such as source control/natural recovery, institutional controls, containment, removal, or treatment that will satisfy the RAOs.

The focus of this FS is on contaminated sediments and river banks. Remedial actions will focus on reductions in concentrations of contaminants in sediment and riverbank soils in conjunction with source control measures is anticipated to reduce concentrations in other media, such as ground water, surface water, upland soils, and air.

2.3.1 No Action

The NCP [40 CFR §300.430(e)(6)] provides that the No Action alternative should be considered at every site. The no action alternative reflects the site conditions described in the baseline risk assessment and remedial investigation report, and serves as a baseline against which the performance of other remedial alternatives may be compared. Under the No Action alternative, contaminated river sediments would be left in place without treatment or containment. ODOH could continue to implement existing fish consumption advisories pursuant to state legal authorities, but no institutional controls or monitoring would be implemented as part of a CERCLA response action for the Study Area. According to the ROD guidance (USEPA, 1999), No Action may be appropriate: 1) when the site or operable unit poses no current or potential threat to human health or the environment; 2) when CERCLA does not provide the authority to take remedial action; or, 3) when a previous response has eliminated the need for further remedial response (often called a "No Further Action" alternative).

2.3.2 Institutional Controls (ICs)

Institutional controls generally refer to non-engineering measures intended to affect human activities in such a way as to prevent or reduce exposure to hazardous substances, often by limiting land or resource use. These controls may have limited effectiveness and usually have no ability to reduce ecological exposures. Institutional controls are typically implemented in conjunction with other remedy components. They may be used to limit human exposure by instituting fish advisories during monitored or enhanced natural recovery. Institutional controls may also be used to protect in-situ caps from boat anchoring and keel dragging, structure and utility maintenance and repair, and future maintenance dredging.

2.3.3 Monitored Natural Recovery (MNR)

Natural recovery typically uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment. These processes may include physical (burial and sedimentation), biological (biodegradation), and chemical (sorption and oxidation) mechanisms that act together to reduce the risk posed by the contaminants. However, not all natural processes result in risk reduction; some may increase or shift risk to other locations or receptors. MNR includes monitoring to assess whether these natural processes are occurring and at what rate they may be reducing contaminant concentrations, but does not include active remedial measures. MNR should be considered as a stand-alone remedy only when it would meet remedial objectives within a time frame that is reasonable compared to active remedies (USEPA, 2005). Factors that should be considered in determining whether the time frame for MNR is "reasonable" include the following:

- The extent and likelihood of human exposure to contaminants during the recovery period, and if addressed by institutional controls, the effectiveness of those controls;
- The value of ecological resources that may continue to be impacted during the recovery period;
- The timeframe in which affected portions of the site may be needed for future uses which will be available only after MNR has achieved cleanup levels; and,
- The uncertainty associated with the time frame prediction.

MNR may also be used as one component of a total remedy, either in conjunction with active remediation or as a follow-up measure to monitor the continued reduction of contaminant concentrations.

2.3.4 Enhanced Monitored Natural Recovery (EMNR)

In areas where natural recovery is occurring, but not at a rate sufficient to reduce risks within an acceptable time frame, enhancement or acceleration of the recovery process by engineering means, for example by the addition of a thin layer of clean sediment, can be utilized. This approach is sometimes referred to as "thin-layer placement" or "particle broadcasting." Thin-layer placement normally accelerates natural recovery by adding a layer of clean sediment over contaminated sediment. The acceleration can occur through several processes, including increased dilution through bioturbation of clean sediment mixed with underlying contaminants. Thin-layer placement is typically different than the isolation caps because it is not designed to provide long-term isolation of contaminants from benthic organisms.

The thickness of the material used in thin layer placement generally ranges from 3-6 inches. The grain size and organic carbon content of the clean sediment to be used for thin-layer placement need to be carefully considered in consultation with aquatic biologists. In most cases, natural materials (as opposed to manufactured materials) approximating common substrates found in the area should be used. Clean sediment can be placed in a uniform thin layer over the contaminated area or it can be placed in berms or windrows, allowing natural sediment transport processes to distribute the clean sediment to the desired areas.

Another option that can be considered for EMNR include the addition of flow control structures to enhance deposition in certain areas of a site. Enhancement or inception of contaminant degradation through additives might also be considered to speed up natural recovery. However, when evaluating the feasibility of these approaches, state and federal water programs should be consulted regarding the introduction of clean sediment or additives to the water body. For example, in some areas, potentially erodible clean sediment already is a major nonpoint source pollution problem, especially in areas near sensitive environments such as those with significant subaquatic vegetation or shellfish beds.

2.3.5 Containment

Containment entails the physical isolation (sequestration) or immobilization of contaminated sediment by an engineered cap, thereby limiting potential exposure to, and mobility and bioavailability of contaminants bound to the sediment. Capping technologies require long-term monitoring and maintenance in perpetuity to ensure that containment measures are performing successfully because contaminated sediment is left in place.

Containment in place refers to the placement of clean material over contaminated sediments. Caps are generally constructed of granular material, such as suitable fine-grained sediment, sand, or gravel, but can have more complex designs. Caps are designed to reduce potentially unacceptable risk through: 1) physical isolation of the contaminated sediment or soil to reduce exposure due to direct contact and to reduce the ability of burrowing organisms to move contaminants to the surface; 2) stabilization and erosion protection to reduce re-suspension or erosion and transport to other sites; and/or 3) chemical isolation of contaminated media to reduce exposure from contaminants transported into the water column. Caps may be designed with different layers (including "active" capping layers that provide treatment) to serve these primary functions or in some cases a single layer may serve multiple functions.

2.3.6 In-Situ Treatment

In-situ treatment of sediments refers to chemical, physical, or biological techniques for reducing contaminant concentrations, toxicity, or mobility while leaving the contaminated sediment in place. In-situ treatment requires site-specific treatability studies to determine the effectiveness of the treatment technology in the environment of the Study Area.

2.3.7 Removal

Removal of sediments can be accomplished either while submerged (dredging sediments) or after water has been diverted or drained (excavation of soils or sediments). This response results in the removal of contaminant mass from the river bed. Both methods typically necessitate transporting the sediment to a location for treatment and/or disposal. They also frequently include treatment of water from dewatered sediment prior to discharge to an appropriate receiving water body.

Removal or dredging for environmental purposes should be distinguished from maintenance or navigation dredging. Environmental dredging is intended to remove sediment contaminated above certain action levels while minimizing the spread of contaminants to the surrounding environment during dredging [National Research Council (NRC) 1997] while navigation dredging is intended to maintain waterways for recreational, national defense, and commercial purposes.

After removal, sediment often is transported to a staging or re-handling area for dewatering (if necessary), and further processing, treatment, or final disposal. Transport links all dredging or excavation components and may involve several different modes of transport. The first element in the transport process is to move sediment from the removal site to the disposal, staging, or re-handling site. Sediment may then be transported for pretreatment, treatment, and/or ultimate disposal (USEPA 1994).

2.3.8 Ex-Situ Treatment

Ex-situ treatment involves the application of chemical, physical or biological technologies to transform, destroy, or immobilize contaminants following removal of contaminated sediments. Depending on the contaminants, their concentrations, and the composition of the sediment treatment of the sediment to reduce the toxicity, mobility, or volume of the contaminants before disposal may be warranted. Available disposal options and capacities may also affect the decision to treat some sediment. In general, treatment processes have the ability to reduce sediment contaminant concentrations, mobility, and/or sediment toxicity by contaminant destruction or by detoxification, by extraction of contaminants from sediment, by reduction of sediment volume, or by sediment solidification/stabilization.

The treatment of contaminated sediment is not usually a single process, but often involves a combination of processes or a treatment train to address various contaminant problems, including pretreatment, operational treatment, and/or effluent treatment/residual handling. Pretreatment modifies the dredged or excavated material in preparation for final treatment or disposal. When pretreatment is part of a treatment train, distinguishing between the two components may be difficult and is not always necessary. Pretreatment is generally performed to condition the material to meet the chemical and physical requirements for treatment or disposal, and/or to reduce the volume and/or weight of sediment that requires transport, treatment, or restricted disposal. Pretreatment processes typically include dewatering and physical or size separation technologies.

After ex-situ treatment, treated dredged sediment could either be beneficially used (assuming appropriate characterization) or disposed on land or in water. Both of these GRAs are discussed in the following subsections.

2.3.9 Beneficial Use of Dredged Sediments

Following removal and, if necessary, ex-situ treatment, dredged material could potentially be beneficially used. Sediment that meets applicable criteria for contaminant concentrations and structural properties could serve a beneficial purpose such as structural fill, lower permeability cover soils, or capping for a brownfield or landfill without pre-treatment. In some instances, ex-situ treatment, such as ex-situ immobilization, is required prior to application of dredged sediment as fill or cover material. In addition, certain ex-situ treatment processes result in an end product that can be beneficially used (such as formation of glass following vitrification or cement aggregate following certain thermo-chemical processes).

2.3.10 Disposal

Disposal refers to the placement of dredged or excavated material and process wastes into a temporary or into a permanent structure, site, or facility. The goal of disposal is generally to manage sediment and/or residual wastes to prevent contaminants associated with them from impacting human health and the environment.

Disposal of removed media can either be within an in-water disposal facility specifically engineered for the sediment remediation, (such as in a confined aquatic disposal [CAD] location or confined disposal facility [CDF]) or within an upland landfill disposal facility such as operating commercial landfills.

Contaminated sediments that have been removed from the environment are typically managed in upland sanitary landfills, or hazardous or chemical waste landfills. They can also be managed within an in-water disposal facility specifically engineered for the sediment remediation. In addition, the material may have a beneficial use in an environment other than the aquatic ecosystem from which it was removed (such as foundation material beneath a newly constructed brownfields site), especially if the sediment has undergone treatment.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

This section identifies and screens remedial technology types, and process options that are potentially applicable to remediate contaminated sediment in the Study Area. The technology selection and screening processes are conducted in accordance with the RI/FS guidance (USEPA, 1988), the Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (USEPA, 2002a), and the Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (USEPA, 2005). Remedial technologies that are retained for further consideration based on site-specific data will be assembled into remedial action alternatives in Section 3.

The identified technology types are initially screened for technical implementability as described in Section 2.3.1 and then expanded into lists of potentially applicable process options as discussed in Section 2.3.2, and screened further for effectiveness, implementability, and relative cost. Ancillary technologies, such as sediment dispersion control options, sediment dewatering, wastewater treatment, and sediment transportation options are discussed in Section 2.3.3. Technologies and process options that were retained after the effectiveness, implementability, and cost screening are summarized in Section 2.3.4 and representative process options are selected in Section 2.3.5.

2.4.1 Identification and Initial Screening of Remedial Technologies and Process Options

Following EPA's RI/FS guidance (1988), the universe of potentially applicable technology types and process options identified for this site is reduced through an evaluation of technical implementability. Technology types refers to general categories of technologies while process options refers to specific processes within each technology type. The screening of technologies is based on the current Site uses and conditions and/or reasonable likely future conditions and uses for navigation and maintenance dredging issues. During this screening step, process options and entire technology types are eliminated from further consideration on the basis of technical implementability. Technology types presented in this section are grouped by GRA as identified in Section 2.3.

The evaluation of technical implementability was based on a general understanding of the chemical and physical characteristics at the site. **Table 2.3-1** presents remedial technologies and process options potentially applicable for each GRA at the Site. Shaded technologies and process options are not retained for further consideration based on implementability at this site. Remedial technologies and process options eliminated based on technical implementability were limited to certain in-situ and ex-situ treatment technologies and certain disposal options. The technology types that are retained after this initial screening are discussed in Section 2.3.5.

2.4.2 Evaluation and Screening of Process Options

Process options that are determined to be technologically implementable in **Table 2.3-1** are further evaluated in greater detail in this section in order to select one process to represent each technology type for further detailed evaluation in the FS. In some cases more than one process option may be selected for a technology type when two or more processes are sufficiently different in their performance that one would not adequately represent the other. The selection of a representative process for each technology type is solely for the purpose of simplifying the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. The representative process provides a basis for developing performance specifications during preliminary design. However, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase.

Process options are evaluated using the same criteria – effectiveness, implementability, and cost – that are used to screen alternatives prior to the detailed analysis. An important distinction to make is that at this time these criteria are applied only to technologies and the general response actions they are intended to satisfy and not to the site as a whole. Furthermore, the evaluation focuses on effectiveness factors at this stage with less effort directed at the implementability and cost evaluation. The evaluation of process options was conducted using the following criteria:

- **Effectiveness:** Effectiveness is evaluated relative to other processes within the same technology type. This evaluation focuses on the ability to handle the estimated areas or volumes of contaminated sediment and meeting the PRGs, potential impacts to human health and the environment during the construction and implementation phase, and how proven and reliable the process is with respect to the contaminants and conditions at the site.
- **Implementability:** Implementability evaluates each technology for technical and administrative feasibility of implementing a technology process. Since technical implementability is used as an initial screen of technology types and process options to eliminate those that are clearly ineffective or unworkable at this site, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability. Administrative feasibility refers to the ability to obtain permits for off-Site actions (on-Site actions would be performed under CERCLA authorities), the availability of treatment, storage, and disposal services (including capacity), and the availability of specific equipment and technical specialists.
- **Relative Cost:** Cost plays a limited role in the screening of process options. Both capital and operation and maintenance (O&M) costs are considered rather than detailed cost estimates. The cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are low, moderate, or high relative to

the other options within the same technology type.

Table 2.2-2 presents the effectiveness, implementability, and cost screening of technologies and process options. Technologies and process options that are retained after this screening are summarized in Section 2.3.5. The initial screening of technical implementability and subsequent evaluation remedial technologies are presented on a technology-specific basis in the following sections.

2.4.3 Ancillary Technologies

Additional technologies and process options that are ancillary to the retained process options presented in Section 2.3.3 may be incorporated into any remedial alternative implemented in the FS Study Area. These ancillary systems are described here in relation to their potential applicability to some of the primary technologies that are evaluated in Section 2.3.2.

2.4.3.1 Sediment Dispersion Control

Water-borne transport of re-suspended contaminated sediment released during dredging can often be reduced by using physical barriers around the dredging operation area. Two of the more common approaches include silt curtains and sheet pile walls.

Silt curtains are floating barriers designed to control the dispersion of sediment in a body of water. They are made of impervious flexible materials such as polyester-reinforced thermoplastic (vinyl) and coated nylon. The effectiveness of silt curtains and screens is primarily determined by the hydrodynamic conditions in a specific location. Under ideal conditions, turbidity levels in the water column outside the curtain can be as much as 80 to 90 percent lower than the levels inside or upstream of the curtain (Francingues and Palermo, 2005). Conditions that may reduce the effectiveness of these and other types of barriers include significant currents, high winds, changing water levels and current direction (i.e., tidal fluctuation), excessive wave height, and drifting ice and debris (USEPA, 2005). Silt curtains are generally more effective in relatively shallow, quiescent water, as water depth and turbulence due to currents and waves increase, it becomes more difficult to effectively isolate the dredging operation from the ambient water.

In general, the use of silt curtains is not expected to be effective in the main channel of the Study Area during dredging operations due to the presence of significant currents and tidal fluctuations. Consideration has been given to the use of silt curtains at off-channel areas (coves, embayments, slips, and lagoons) where the water velocities are much lower. In areas with working ship traffic, this approach would require developing a method for quickly removing and reinstalling the silt curtain during barge unloading operations. Silt curtains are retained for further consideration in the FS.

Sheet piling consists of a series of panels and piling with interlocking connections driven into the subsurface with impact or vibratory hammers to form an impermeable barrier. While the sheets can be made from a variety of materials such as steel, vinyl, plastic, wood, recast concrete, and fiberglass, lightweight materials (plastic, fiberglass, vinyl) are typically surface mounted to the piling.

Sheet pile containment structures are more likely to provide reliable containment of re-suspended sediment than silt curtains, although at significantly higher cost and with different technological limitations. Sheeting and/or piling must be imbedded sufficiently deep into the subsurface to ensure that the sheet pile structure will withstand hydraulic forces (such as waves and currents) and the weight of material (if any) piled behind the sheeting. Sheet pile containment may increase the potential for scour around the outside of the containment area and sediment re-suspension may occur during placement and removal of the structures. The use of sheet piling may significantly change the carrying capacity of a stream or river and make it temporarily more susceptible to flooding (USEPA 2005). Sheet piling may be used in localized areas to prevent migration of highly contaminated sediment during dredging or during disposal operations. Sheet piling is retained for further consideration in the FS.

2.4.3.2 Dewatering Evaluation

After removal, dredged sediment may require dewatering to reduce the sediment water content. Dewatering is considered a form of ex-situ treatment because it reduces the volume and mobility of contaminants. Dewatering technologies are commonly used to reduce the amount of water in dredged sediment and to prepare the sediment for transport and treatment or disposal. In many cases, the dewatering effluent will need to be treated before it can be disposed of properly or discharged back to receiving water. Dewatering is considered in greater detail here than in the physical ex-situ treatment section because of its common application in environmental dredging projects. Several factors must be considered when selecting an appropriate dewatering treatment technology including physical characteristics of the sediment, selected dredging method, and the required moisture content of the material to allow for the next re-handling, treatment, transport, or disposal steps in the process.

Three categories of dewatering that are regularly implemented include passive dewatering, mechanical dewatering, and reagent enhanced dewatering/stabilizing methods. The following sections discuss the effectiveness and implementability of various dewatering process options applicable to the Site.

Passive Dewatering

Passive dewatering (also referred to as gravity dewatering) is facilitated through natural evaporation, consolidation, and drainage of sediment pore water to reduce the dredged sediment water content. Passive dewatering is usually applied to mechanical dredging process options when space permits. It is most often facilitated through the use of an onshore temporary holding facility such as a dewatering lagoon or temporary settling basin. In-barge settling and subsequent decanting can also be an effective passive dewatering method and can reduce the overall time needed for onshore passive dewatering operations. Passive dewatering techniques can also be applied to sediment that has been hydraulically dredged where the resulting slurry is pumped into a consolidation site and the sediment slurry is allowed to settle, clarify, and dewater by gravity after the site has reached capacity. Water generated during the dewatering process is typically discharged to receiving waters directly after some level of treatment, or may be captured and transported to an off-site treatment and discharge location. Normal passive dewatering typically requires little or no treatability testing, although characteristics of the sediment such as grain size, plasticity, settling characteristics and NAPL content are typically considered to determine specific dewatering methods, to size the dewatering area, and to estimate the timeframe required for implementation.

Passive dewatering is generally effective and capable of handling variable process flow rates but can require significant amounts of space (depending on the volume of material processed and the settling characteristics of the sediment) and time for significant water content reduction. Passive dewatering is a widely implemented dewatering technology for mechanically dredged sediments. It is also amenable to hydraulic dredging with placement into a settling basin or with the use of geotextile tubes to confine slurry and sediment during passive dewatering. Hydraulic dredge sediment dewatering with geotextile tubes has been implemented at several sites but typically requires project-specific bench-scale evaluations during remedial design to confirm its compatibility with Site sediments and to properly select and size the geotextile tubes.

Depending on the desired moisture content of the sediment, the subsequent processing or handling steps, the volume of material to be dewatered, available space, and the ability to effectively manage the dewatering effluent, passive dewatering can be a highly implementable dewatering technology option. Passive dewatering has been retained as a process option for the Portland Harbor Site with in-barge passive dewatering selected as the representative process option for inclusion in the development of alternatives.

Mechanical Dewatering

Mechanical dewatering involves the use of equipment such as centrifuges, hydrocyclones, belt presses, or plate-and-frame filter presses to separate coarse materials, or squeeze, press, or otherwise draw out water from sediment pore spaces. Mechanical dewatering is typically used in combination with hydraulic dredging to reduce the water content of the dredge slurry prior to beneficial reuse (such as sands retained from particle separation methods), ex-situ treatment (e.g., thermal), and/or disposal of the dewatered sediment. Mechanical dewatering may also be used in combination with mechanical dredging if the dredge material is hydraulically re-slurried from the barge. Sufficient onshore space is needed to accommodate the selected dewatering equipment, but this space is usually less than required for passive dewatering. A mechanical dewatering treatment train usually includes treating the dewater prior to discharge.

The mechanical dewatering treatment train typically includes screening to remove materials such as debris, rocks, and coarse gravel. If appropriate, polymers may be added for thickening prior to dewatering. These steps result in a dewatered cake that achieves project-specific volume and weight reduction goals of the dredged sediment. The mechanical dewatering process can be scaled to handle large volumes of sediment, but requires operator attention, consistent flow rates, and consistent sediment feed quality.

Mechanical dewatering is generally an effective technology for both hydraulic and mechanical dredging and has been widely implemented for a range of sediment types and sediment end uses (such as beneficial reuse and upland disposal) and is likely the most effective method of achieving moisture content reduction over shorter timeframes than passive dewatering. Bench-scale tests are often performed during remedial design to develop the specific process design, select equipment, and to select polymer additives if appropriate. Mechanical dewatering has been retained as a process option for contaminated sediments at the Portland Harbor Site and may be used where appropriate based on area specific design needs.

Reagent Dewatering

Reagent dewatering is an innovative ex-situ treatment method in the category of stabilization/solidification methods, which are discussed along with other categories of ex-situ treatment. This technology removes water by adding a reagent to the bulk sediment that binds with the water within the sediment matrix to immobilize the leachable contaminants (typically metals) and/or enhance geotechnical properties. This process increases the mass of sediment due to the addition of the reagent mass. For situations where dewatering is the single goal, the most cost-effective, available, and effective reagent or absorptive additive is used, which depending on site conditions and economics could include quicklime, Portland cement, fly ash, diatomaceous earth, or sawdust, among others. Reagent mixtures can be optimized to provide enhanced strength or leachate retardation to meet specific project requirements.

Dewatering by the addition of reagents is effective and has similar or smaller space and operational requirements as mechanical dewatering. In some cases, reagent addition and mixing can be conducted as part of the dredge material transport and re-handling process, either on the barge or as dredge material is loaded into trucks or rail cars. In other cases it can be added and mixed after offloading to the upland staging area. Also reagent addition may be used in combination with other forms of dewatering (e.g., filter press) and ex-situ treatment. Bench-scale testing is often necessary to determine the optimum reagent mixture prior to construction. However, case study information is available from other projects on the types of reagents used for sediments of various water contents, and this information is sufficient to determine the general effectiveness and implementability of this

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technology for this FS. For example, the Gasco Early Action used in-barge application and mixing of Portland cement as well as diatomaceous earth at the transload facility as a final dewatering "polishing" step. This approach required no extra upland treatment space or major changes to the transport and transload steps that would have otherwise been used.

A wide range of dewatering process options are likely feasible at the Site. As a result, reagent dewatering has been retained as a process option for contaminated sediments at the Portland Harbor Site and may be used where appropriate based on area specific design needs.

2.4.3.3 Wastewater Treatment

Dewatering dredged material requires managing the wastewater generated during the dewatering process (dredged material typically has a water content ranging from 50 to 98 percent depending on the dredging method) along with contact water (such as precipitation that has been in contact with contaminated material, decontamination water, and wheel wash water) from other facility operations. The purpose of wastewater treatment is to prevent adverse impacts on the receiving water body from the dewatering discharge to the Lower Willamette River.

A wastewater treatment plant would typically be included as part of the on-site management of dredged material. An on-site wastewater treatment plant to manage wastewater for a facility handling sediment from the Portland Harbor Site may include coagulation, clarification, multi-stage filtration, and granular activated carbon adsorption with provision for metals removal, if necessary. The primary difference in the wastewater treatment plant for a hydraulic dredging operation as compared to a mechanical dredging operation would be the volume of wastewater to be treated; hydraulic dredging results in a larger volume of sediment-water slurry to be managed. The hydraulic dredging wastewater treatment plant would require a larger footprint. An on-site wastewater treatment system is retained for further consideration.

2.4.3.4 Transportation

Transportation would be a component for any remedial alternative that involves removal of contaminated sediments from the Portland Harbor Site. The transportation method included in each remedial alternative would be based upon the compatibility of that transportation method to the other process options. The most likely transportation methods are truck, rail, and barge. These are briefly discussed below. Appendix ?? includes a summary of waterborne, rail, and road access associated with potential sediment processing or placement sites.

Truck Transport

Truck transportation includes the transport of dewatered dredged material over public roadways using dump trucks, roll-off boxes, or trailers. This form of transportation is the most flexible but can be very costly over long haul distances. Truck transport also has the greatest potential to impact local streets and traffic depending on the location of the processing facility with respect to major highways. Transportation of dredged sediments via truck is retained for further consideration.

Rail Transport

Rail transportation includes the transport of dewatered dredged material via railroad tracks using gondolas or containers. Rail transport is desirable where sediment is shipped over long distances, for example, to out-of-state treatment or disposal facilities. Because rail transport requires coordination between multiple owners and many operators are unwilling to provide detailed information prior to entering actual negotiations, it is difficult to obtain accurate cost estimates. Rail transport may require the construction of a rail spur from a sediment handling facility to a main rail line. Transportation of dredged sediments via rail is retained for further consideration.

Barge Transport

Barge transportation includes the transport of dredged solids directly to a processing (dewatering) or disposal (CAD site or CDF) facility, or the transport of dewatered dredged material to a trans-shipment or disposal facility. Barge transport would likely be used for short distances such as from the dredging location to the dredged material handling facility. In addition, barge transport may be considered for longer distances if dredged material is hauled to out-of-state treatment or disposal locations that have the ability to accept barge-loaded dredged material. Transportation of dredged sediments via barge is retained for further consideration.

2.4.4 Summary of Retained Remedial Technologies and Process Options

In addition to the No Action response, the following process options have been retained for further evaluation:

- Institutional controls, including, but not limited to, fish and shellfish consumption advisories, recreational boating restrictions, and dredging and structural maintenance restrictions in capping areas.

- Monitored natural recovery processes, including, but not limited to, burial, sedimentation, bio-degradation, sorption, and oxidation.

- Enhanced monitored natural recovery, including, but not limited to, thin layer capping.

- In-situ treatment using physical immobilization, including, but not limited to, solidification/stabilization and sequestration.

- Containment via engineered caps (including stone or clay aggregate material as armor), reactive caps, and geotextiles.

- Sediment removal via excavation, mechanical and hydraulic dredging, and use of specialized and small scale dredge equipment.
- Ex-situ treatment via particle separation, solidification/stabilization, and sediment washing.
- Disposal in an off-site landfill, RCRA disposal facility, or CDF.

2.4.5 Selection of Representative Technologies and Process Options

To proceed further with the development of the remedial alternatives and to evaluate and develop costs in subsequent chapters for this FS, it is necessary to select representative technologies and process options. Other process options may be identified and selected during the design phase of the remedy.

No Action:

The No Action response does not include any containment, removal, disposal, or treatment of contaminated sediments, no new institutional controls, and no new monitoring.

Institutional Controls:

Existing ODOH fish consumption advisories would continue under any of the remedial actions. Further, enhanced outreach to educate community members about the ODOH consumption advisories and to emphasize that advisories would remain in place during and after remediation would be incorporated into the active remedial alternatives. Outreach activities would focus on communities (typically economically disadvantaged groups) known to engage in sustenance fishing, with a special emphasis on sensitive populations (children, pregnant women, nursing mothers). These activities could also include posting multilingual signs in fishing areas, distributing illustrated, multi-lingual brochures, and holding educational community meetings and workshops.

Additional institutional controls such as restrictions or special conditions (e.g., to protect the integrity of engineered caps) imposed on sediment disturbance activities could also be implemented as components of alternatives comprising active remedial measures.

Monitored Natural Recovery:

As discussed in Section 2.3.1.3, MNR could be included as a component of alternatives comprising active remedial measures. It includes monitoring of the water column, sediment, and biota tissue to determine the degree to which they

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are recovering to PRGs. Once active remediation is completed, the influx, mixing and deposition of sediment originating from suspended sediment upriver would subsequently determine the extent to which the sediment surface in the FS Study Area is recovering from upriver sediments. However, the Study Area is the major source of contaminants to the river; so remediation of the Study Area would reduce the major source of contamination to the Multnomah Channel and Columbia River.

<u>Sediment Containment</u>:

Several process options using a variety of materials for sediment containment are retained including engineered caps (using stone or clay aggregate material as armor), active caps, and geotextiles. Due to the large area being considered for remediation and the limited precedent for using geotextiles, engineered sand caps with, and without, stone armor are selected as the representative process option for alternatives involving sediment containment. Reactive caps are retained to be used in areas where there are groundwater plumes to eliminate the potential for the groundwater plume from entering the river environment.

<u>Sediment Removal</u>:

Three process options for sediment removal were retained including excavation, hydraulic dredging, and mechanical dredging. Specialized and small scale dredge equipment was also retained, but will have limited use in the remedy for this site. The costs of remedial alternatives involving sediment removal are based on mechanical dredging as the representative process option because of the following:

- The additional challenges to implementability associated with the infrastructure needs for hydraulic dredging in the Portland Harbor area.
- The availability of site-specific data regarding implementation.

Although it would be possible to extend a hydraulic transport pipeline across the Willamette River by submerging it, due to the presence of berths and shipping lanes it is preferable to locate a dewatering facility of sufficient size close to the Study Area for the hydraulic dredging option.

<u>Sediment Treatment</u>:

Process options retained for treatment include particle separation, solidification/stabilization, and sediment washing. Depending on the concentrations of COCs, the four process options could be used for treatment of the dredged materials from the Study Area. The effectiveness of solidification/stabilization treatment is highly dependent on the initial COC and concentrations; therefore, it is more suitable for sediment with lower COC concentrations.

The effectiveness of sediment washing also depends on the types of COCs that are present as well as their initial concentrations. A pilot study of sediment washing using Lower Passaic River sediment (BioGenesisSM Enterprises, Inc., 2009), indicated that certain contaminants like VOCs, dioxins and metals were treated more efficiently than PAHs and PCBs. The results of a 2012 bench scale study (de maximis, inc., 2012) failed to show any reduction in dioxin and PCB concentrations in highly contaminated sediments.

For sediments with in-situ COC concentrations between one and ten times the universal treatment standard (UTS), sediment washing is selected as the representative treatment process option for purposes of developing the remedial alternatives and cost estimates. For sediments with in-situ COC concentrations below both the UTS and the NRDCSRS, solidification/stabilization is selected as the representative treatment process option. Other treatment processes may be considered during the design phase.

<u>Disposal of Dredged Sediments</u>:

The three process options for disposal include an off-site landfill, a RCRA disposal facility and a CDF. RCRA regulations exclude dredged material that is subject to the requirements of CWA Section 404, which governs the disposal of the sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. In addition, a CDF is more efficiently integrated with dredging (e.g., transporting and offloading dredged material to a CDF causes fewer short-term impacts to the community and would be more cost-effective than transporting and offloading to an off-site landfill. Therefore, a CDF site is selected as the representative process option for disposal of dredged sediments.

However, to provide greater flexibility in managing large quantities of dredged material, disposal in an off-site landfill has also been retained as an alternative representative process option. Many RCRA Subtitle C and D landfills are located in the United States. Non-hazardous dredged materials (as defined under RCRA) are eligible for direct landfill disposal at a RCRA Subtitle C or D facility if in compliance with the individual acceptance criteria of the receiving facility. Hazardous dredged material that contain UHCs exceeding the UTS, but do not contain UHCs exceeding ten times the UTS for soil or sediment are eligible for direct landfill disposal at a RCRA Subtitle C facility, if the material is in compliance with the individual acceptance criteria of the receiving facility.

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Appendix B1 – Human Health Risk-Based Preliminary Remediation Goal (PRG) Derivation

1.0 Introduction

This section presents the calculation of risk-based preliminary remediation goals in sediment and biota. Risk-based PRGs were calculated for all contaminants that posed an excess lifetime cancer risk greater than 1 x 10^{-6} or a hazard quotient greater than 1 in the final Portland Harbor Baseline Human Health Risk Assessment (Kennedy/Jenks 2013) assuming reasonable maximum exposure. For cancer effects, risk-based PRGs were calculated as the concentration consistent with a specified target excess cancer risk (TR) of 1×10^{-6}. For non-cancer effects, the risk-based PRGs were the calculated concentration that would result in a specified target hazard quotient (THQ) of 1. For both cancer and noncancer effects, the PRGs are calculated based on specified exposure pathways and receptors. Exposure values are summarized in Table 1, and unless otherwise noted, the source for each value is provided in Tables 3-21 through 3-25 in the Final Portland Harbor BHHRA.

1.1 PRGs for Direct contact with Sediment

Risk-based PRGs based on direct-contact pathways with sediment are calculated to account for incidental ingestion and dermal exposures. These values are then combined to derive a single risk-based PRG protective of both exposure pathways.

1.1.1 Incidental Ingestion of Sediment

Risk-based PRGs associated with the incidental ingestion of sediment were calculated for child or adult receptors as appropriate using the following equations adapted from Section 3.5.1 of the Final BHHRA:

Noncancer effects:

$$PRG_{\text{sed-nc}} = \frac{THQ \times BW \times AT_{nc}}{EF \times ED \times \frac{1}{RfD} \times IRS \times 10^{-6}\, kg/mg}$$

Carcinogenic effects:

$$PRG_{\text{sed-c}} = \frac{TR \times BW \times AT_{c}}{EF \times ED \times CSF \times IRS \times 10^{-6}\, kg/mg}$$

Risk-based PRGs based on carcinogenic effects, and where exposure was assumed to occur from childhood through adult years were age-weighted using the following equation:

$$PRG_{sed-c} = \frac{TR \times AT_c}{CSF \times EF \times IFS_{adj} \times 10^{-6}\, kg/mg}$$

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{ED_a \times IRS_a}{BW_a}$$

and:

PRG_{sed} = risk-based PRG in soil or sediment (µg/kg or mg/kg)
IFS_{adj} = age-adjusted soil/sediment incidental ingestion factor [(mg-year)/(kg-day)]
IRS_a = incidental sediment ingestion rate-adults (mg/day)
IRS_c = incidental sediment ingestion rate-children (mg/day)
EF = exposure frequency (days/year)
ED_a = exposure duration – adult (years)
ED_c = exposure duration – child (years)
BW_a = body weight – adult (kg)
BW_c = body weight – child (kg)
AT_{nc} = averaging time, noncancer (days)
AT_c = averaging time, cancer (days)
THQ = target hazard quotient
TR = target excess cancer risk
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$

The following equation was used to calculate risk-based PRGs in sediment for contaminants known to be mutagenic (cPAHs), and incorporates the age-dependent adjustment factors (ADAFs) of 10 and 3, respectively, for exposures occurring before 2 years of age and from ages 2 through 16 (see section 3.5.7 of the BHHRA):

$$PRG_{sed-m} = \frac{TR \times AT_c}{EF \times CSF \times ISIFM_{adj} \times 10^{-6}\, kg/mg}$$

$$ISIFM_{adj} = \left(\begin{array}{l} \frac{(ED_{0\text{-}2} \times IRS_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRS_c) \times 3}{BW_c} + \\ \frac{(ED_{6\text{-}16} \times IRS_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRS_a) \times 1}{BW_a} \end{array} \right)$$

where:

PRG_{sed} = chemical concentration in soil or sediment (mg/kg)
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)
$ISIFM_{adj}$ = incidental sediment ingestion factor for mutagens (mg-yr/kg-day)
EF = exposure frequency (days/year)

ED_{0-2} = exposure duration ages 0-2 (years)
ED_{2-6} = exposure duration ages 2-6 (years)
ED_{6-16} = exposure duration ages 6-16 (years)
ED_{16-30} = exposure duration ages 16-30 (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT_c = averaging time, carcinogens (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$
RfD = reference dose (mg/kg-day)
THQ = target hazard quotient
TR = target excess cancer risk

The exposure assumptions are provided in Table 1.

1.1.2 Dermal Contact with Sediment

Risk-based PRGs for dermal contact with sediment were calculated for child or adult receptors as appropriate using the following equations adapted from Section 3.5.2 of the Final BHHRA:

Non-cancer effects:

$$PRG_{sed} = \frac{THQ \times AT_{nc} \times BW}{EF \times ED \times \frac{1}{RfD} \times SA \times AF \times ABS \times 10^{-6} kg/mg}$$

Cancer effects:

$$PRG_{sed} = \frac{TR \times AT_c \times BW}{EF \times ED \times CSF \times SA \times AF \times ABS \times 10^{-6} kg/mg}$$

Combined child and adult age-weighted exposures resulting from dermal contact with contaminants in sediment for the recreational beach user exposure scenarios were calculated consistent with the following equations:

$$PRG_{sed} = \frac{TR \times AT_c}{CSF \times EF \times DFS_{adj} \times 10^{-6} kg/mg}$$

where:

$$DFS_{adj} = \frac{ED_c \times EF_c \times AF_c \times SA_c}{BW_c} + \frac{ED_a \times EF_a \times AF_a \times SA_a}{BW_a}$$

and:

PRG_{sed} = concentration in soil or sediment (μg/kg or mg/kg)
DFS_{adj} = age-adjusted dermal contact factor [(mg-year)/(kg-day)]

ABS_{dermal} = dermal absorption efficiency
SA_a = exposed skin surface area – adult (square centimeters [cm^2])
SA_c = exposed skin surface area – child (cm^2)
AF_a = soil-to-skin adherence factor – adult (mg/cm^2)
AF_c = soil-to-skin adherence factor – child (mg/cm^2)
EF = exposure frequency (days/year)
ED_a = exposure duration – adult (years)
ED_c = exposure duration – child (years)
BW_a = body weight – adult (kg)
BW_c = body weight –child (kg)
AT = averaging time (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$
RfD = reference dose (mg/kg-day)
THQ = target hazard quotient
TR = target excess cancer risk

Risk-based PRGs for cPAHs based on dermal exposure to sediments were also calculated as using the early-life exposure adjustments described in Section 1.1.3:

$$PRG_{sed} = \frac{TR \times AT}{EF \times CSF \times DSCFM_{adj} \times ABS \times CF}$$

Where:

$$DSCFM_{adj} = \left(\frac{ED_{0\text{-}2} \times AF_c \times SA_c \times 10}{BW_c} + \frac{ED_{2\text{-}6} \times AF_c \times SA_c \times 3}{BW_c} + \frac{ED_{6\text{-}16} \times AF_a \times SA_a \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times AF_a \times SA_a \times 1}{BW_a} \right)$$

where:

PRG_{sed} = chemical concentration in soil or sediment (mg/kg)
ABS_{dermal} = dermal absorption efficiency
$DSCFM_{adj}$ = dermal sediment contact factor for mutagens (mg-yr/kg-day)
SA_a = adult exposed skin surface area (square centimeters [cm^2])
SA_c = child exposed skin surface area (cm^2)
AF_a = adult soil-to-skin adherence factor (mg/cm^2)
AF_c = child soil-to-skin adherence factor (mg/cm^2)
EF= = exposure frequency (days/year)
$ED_{0\text{-}2}$ = exposure duration ages 0-2 (years)
$ED_{2\text{-}6}$ = exposure duration ages 2-6 (years)
$ED_{6\text{-}16}$ = exposure duration ages 6-16 (years)
ED16-30 = exposure duration ages 16-30 (years)
BWa = adult body weight (kg)
BWc = child body weight (kg)
AT = averaging time (days)
TR = target excess cancer risk

Exposure assumptions are presented in Table 2.

The individual pathway-specific calculations are combined to a total risk-based PRG in sediment using the following equation:

$$PRG_{sed} = \frac{1}{\frac{1}{PRG_{sed} - Ingestion} + \frac{1}{PRG_{sed} - dermal}}$$

1.2 Fish/Shellfish Tissue PRGs

Risk-based preliminary remediation goals (PRGs) are calculated for fish/shellfish tissue and for sediment. Tissue concentrations were calculated as they represent a direct exposure point for human receptors, and because target tissue concentrations are needed to derive sediment PRGs for protection of human health due to fish consumption.

1.2.1 Risk-Based Tissue PRGs for Direct Consumption

Risk-based tissue PRGs associated with consumption of fish and shellfish were calculated for resident fish using the following equations, adapted from Section 3.5.5 of the Final BHHRA:

Non-cancer effects:

$$PRG_{tissue} = \frac{THQ \times BW_c \times AT_{nc}}{ED_c \times EF \times \frac{1}{RfD} \times CR_c \times 0.001\ kg/g}$$

Carcinogenic effects:

$$PRG_{tissue} = \frac{TR \times BW_a \times AT_c}{ED_a \times EF \times CSF \times CR_a \times 0.001\ kg/g}$$

Combined child and adult exposure was evaluated consistent with the following equation:

$$PRG_{tissue} = \frac{TR \times AT_c}{EF \times CR_{adj} \times CSF \times 0.001\ kg/g}$$

where:

$$CR_{f-adj} = \frac{ED_c \times CR_c}{BW_c} + \frac{ED_a \times CR_a}{BW_a}$$

and:

PRG_{tissue} = risk-based concentration in fish/shellfish tissue (µg/kg, wet-weight)

CR_c = consumption rate of fish/shellfish – child (g/day, wet-weight)
CR_a = consumption rate of fish/shellfish – adult (g/day, wet-weight)
$CR_{f\text{-}adj}$ = consumption rate of fish/shellfish – age-adjusted (g/day – wet weight)
EF = exposure frequency (days/year)
ED_c = exposure duration – child (years)
ED_a = exposure duration – adult (years)
BW_c = body weight – child (kg)
BW_a = body weight – adult (kg)
AT_{nc} = averaging time, noncancer (days)
AT_c = averaging time, cancer (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$, see Table 2
RfD = reference dose (mg/kg-day), see Table 2
THQ = target hazard quotient
TR = target excess cancer risk

The exposure assumptions are presented in Table 1.

1.2.2 Risk-Based Tissue PRGs based on Infant Consumption of Breast Milk

Risk-based PRGs in fish and shellfish tissue were calculated using the following equation adapted from Section 3.5.6 of the Final Portland Harbor BHHRA. The equation presumes steady-state conditions where maternal intake via fish consumption occurs over a period greater than the biological half-life of the contaminant in the body. Maternal intake was modified slightly from the method presented in Section 1.1.1 by assuming a maternal body weight of 66 kg, representing an age-weighted value for women aged 15-44 years (ODEQ 2010), consistent with the value used in the Final Portland Harbor BHHRA.

$$PRG_{tissue}\ (\mu g/kg) = \frac{\left(\frac{THQ \times BW_{inf} \times AT_{inf} \times RfD}{f_{mbm} \times CR_{milk} \times ED_{inf}}\right) \times \left[\ln(2) \times f_{fm}\right] \times BW_m \times AT_{nc}}{\left(h \times f_f\right) \times EF_a \times ED_a \times 10^{-3}\, kg/g \times 10^{-3}\, mg/\mu g \times AE \times CR_{fish}}$$

where:

PRG_{tissue} = risk-based PRG in fish/shellfish (μg/kg – wet weight)
THQ = target hazard quotient
RfD = reference dose (mg/kg-day)
AE = absorption efficiency of the chemical
h = biological half-life of chemical in the body (days)
f_f = fraction of absorbed chemical stored in fat
f_{fm} = fraction of mother's weight that is fat
f_{mbm} = fraction of fat in breast milk
CR_{milk} = infant consumption rate of breast milk (kg/day)
CR = maternal consumption rate of fish (g/day)

ED_{inf}	=	exposure duration of breastfeeding infant (days)
EF_a	=	exposure frequency – adult (maternal exposure, days/yr)
ED_a	=	exposure duration – adult (days)
BW_{inf}	=	average infant body weight (kg)
BW_m	=	average body weight – maternal (kg)
AT_{inf}	=	averaging time, infant exposure (days)
AT_{nc}	=	averaging time, noncancer (days)

1.3 Calculation of Risk-Based PRGs in Sediment Based on Consumption of Fish/Shellfish

Target tissue concentrations were calculated using the method described in Section 1.1.1. To calculate sediment PRGs for scenarios where fish consumption is primarily the fillet, it was necessary to determine the relationship between whole body and fillet-only concentrations, because both the BSAFs/BSARs and the FWM are based on whole body concentrations. The whole-body/fillet concentration ratios were calculated using the measured mean whole body and fillet concentrations of each COC on a river mile or fishing zone basis, and are presented in Table 3.

Carcinogenic PAHs (cPAHs)

The Bioaccumulation Modeling Report (Windward, 2015) presented a calculated BSAR for benzo(a)pyrene in field clams as the following equation:

$$\ln(PRG_{sed}) = \frac{\ln(C_{tissue}) - \ln(CF) + 2.47}{0.60}$$

In order to calculate a PRG, the BSAR for benzo(a)pyrene was considered representative of total carcinogenic PAHs. Because the BSAR is based on lipid-normalized tissue and organic carbon normalized, corrections for site organic carbon and the lipid content of clams were incorporated to arrive at a dry-weight sediment concentration:

$$\ln(PRG_{sed}) = \left[\frac{\left(\ln(C_{\text{tissue}}) - \ln(f_{lipid})\right) - \ln(CF) + 2.47}{0.60}\right] + \ln(f_{oc})$$

And:

$$PRG_{\text{sed}} = e^{\left[\frac{\left(\ln(C_{\text{tissue}}) - \ln(f_{lipid})\right) - \ln(CF) + 2.47}{0.60}\right] + \ln(f_{oc})}$$

PRG_{sed}	=	risk-based PRG in sediment, dry weight (μg/kg)
C_{tissue}	=	risk-based target fish/shellfish tissue concentration – wet weight (μg/kg)
CF	=	correction factor (2.31, see Table 4-1, Windward 2009)
f_{oc}	=	fraction organic carbon site sediments, dry weight (0.0171)
f_{lipid}	=	fraction of lipid in clam tissue, wet weight (0.22)

Hexachlorobenzene

Sediment-tissue BSAFs for hexachlorobenzene were developed for large home-range species, no relationship was established for smallmouth bass (Windward, 2015). The general relationship between sediment and tissue concentrations is expressed by the following equation:

$$PRG_{sed} = \frac{C_{tissue}}{BSAF}$$

Correcting for the organic carbon content of sediment and lipid content of fish gives the following equation:

$$PRG_{sed} = \frac{\left[\left(\frac{C_{tissue}}{f_{lipid}}\right) \times f_{oc}\right]}{BSAF}$$

where:

PRG_{sed}	=	concentration in sediment, dry weight (µg/kg)
f_{lipid}	=	lipid content of fish, wet weight (percent)
f_{oc}	=	sediment organic carbon content, dry weight (0.0171)
BSAF	=	biota-sediment accumulation factor (unitless)

BSAFs and percent lipid content used are 2.02 and 5.2 for black crappie, 0.0295 and 2.4 for brown bullhead, and 0.244 and 8.8 for carp.

As noted above, BSAFs were only developed for large home-range species, and not for smallmouth bass. Accordingly, target sediment concentrations ($Conc_{sed}$) were calculated for each species, and the risk-based sediment PRG for hexachlorobenzene was calculated using the following equation:

$$PRG_{sed} = \frac{1}{\frac{1}{Conc_{sed} - Crappie} + \frac{1}{Conc_{sed} - Carp} + \frac{1}{Conc_{sed} - Bullhead}}$$

1.4 PRGs calculated using the Food-Web Model

The Arnot and Gobas food-web model was refined for use at Portland Harbor (Windward, 2015), and accounts for uptake of contaminants via direct incidental ingestion, dietary uptake, and uptake of dissolved contaminants via ingestion and gill uptake. The FWM was calibrated for chlorinated persistent organic contaminants (aldrin, dieldrin, chlordane, DDx, PCBs, and five specific dioxin/furan congeners). Although the final BHHRA evaluated consumption of smallmouth bass, carp, brown bullhead, and crappie, the latter two species are not evaluated in the FWM. The Largescale sucker was used as a surrogate for bullhead, and sculpin as a surrogate for crappie, as they were considered representative of the same trophic group (Windward, 2015). Oregon human health ambient water quality criteria (DEQ, 2011) for consumption of water and organism were initially used for the contaminant concentration in water. Because specific AWQC have not been established for individual dioxin/furan congeners, the value for 2,3,7,8-TCDD was used f0r the input water concentration for all dioxin/furan congeners

The calculated concentrations in whole body fish of each species were converted to fillet concentrations using the whole-body/fillet ratios presented in Table 4. The resulting fillet concentration were further combined as a weighted mean, with each species representing 25 percent of the total diet. The goal-seek function in Excel was then used to iteratively calculate a surface-weighted average sediment concentration that ultimately predicts the target average tissue concentration of the four modeled species. As noted above, Oregon AWQC were initially used to represent post-remedial surface water concentrations. However, in some instances this resulted in the calculation of a sediment PRGs less than zero. The mathematical explanation for this is that dissolved water concentrations alone are predicted to result in estimated tissue concentrations greater than the risk-based target. When this occurred, the water concentration was set to zero, and the target sediment concentration recalculated. This procedure was used for total PCBs, 2,3,7,8-TCDD, and 1,2,3,7,8-PeCDD where the sediment PRGs were calculated based on either a 1 x 10^{-6} target risk or infant exposure via breastfeeding.

1.5 REFERENCES

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Table 1: Exposure Values

Symbol	Description	Subsistence Fisher	Tribal Fisher	Recreational Beach Use	Dockside Worker	In-Water Worker	Infant Consumption of Breast milk
ABS_{dermal}	dermal absorption efficiency (unitless)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
ABS_{oral}	absorption efficiency (mg-yr/kg-day)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
AE	oral absorption efficiency (unitless)	--	--	--	--	--	1
AF_a	soil-to-skin adherence factor – adult (mg/cm^2)	0.3	0.3	0.3	0.2	0.2	--
AF_c	soil-to-skin adherence factor – child (mg/cm^2)	--	--	3.3	--	--	--
AT_{nc}	averaging time – noncarcinogenic effects (days)	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr
AT_c	averaging time – carcinogenic effect (days)	25,550	25,550	25,550	25,550	25,550	--
AT_{inf}	averaging time – infant exposure (days)	--	--	--	--	--	365
BW_a	body weight – adult (kg)	70	--	70	70	70	70
BW_m	body weight – maternal body weight, kg	66	66	66	66	66	--
BW_c	body weight – child (kg)	15	--	15	--	--	--
BW_{inf}	average infant body weight (kg)	--	--	--	--	--	7.8
CR_a	consumption rate of fish/shellfish – adult (g/day, wet-weight)	142/3.3	--	--	--	--	142
CR_c	consumption rate of fish/shellfish – child (g/day, wet-weight)	60/--	--	--	--	--	--
CR_{milk}	infant consumption rate of breast milk (kg/day)	--	--	--	--	--	0.98
ED_{0-2}	exposure duration ages 0-2 (years)	--	--	2	--	--	--
ED_{16-30}	exposure duration ages 16-30 (years)	--	--	14	--	--	--
ED_{2-6}	exposure duration ages 2-6 (years)	--	--	4	--	--	--
ED_{6-16}	exposure duration ages 6-16 (years)	--	--	10	--	--	--
ED_a	exposure duration – adult (years)	30	70	30	25	10	--
ED_c	exposure duration – child (years)	6	--	6	--	--	--
ED_{inf}	exposure duration of breastfeeding infant (days)	--	--	--	--	--	365
EF_a	exposure frequency – adult (days/year)	350/156[a]	260	94	50	10	350
f_f	fraction of absorbed chemical stored in fat	--	--	--	--	--	0.9
f_{fm}	fraction of mother's weight that is fat	--	--	--	--	--	0.3
f_{mbm}	fraction of fat in breast milk	--	--	--	--	--	0.04
h	biological half-life of chemical in the body (days)	--	--	--	--	--	See Table 3
IRS_a	incidental sediment ingestion rate-adults (mg/day)	100	100	100	--	200	--
IRS_c	incidental sediment ingestion rate-children (mg/day)	--	--	200	--	--	--
SA_a	exposed skin surface area – adult (cm^2)	1,980/5,700[b]	1,980/5,700	5,700	3,300	3,300	--
SA_c	exposed skin surface area – child (cm^2)	--	--	2,800	--	--	--
THQ	target hazard quotient	1	1	1	1	1	1
TR	target cancer risk	1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}	--

a – 350 days/year fish consumption and 156 days/year sediment contact while fishing
b – beach/in-water sediment

Table 2: Chemical-Specific Values

Chemical	SF (mg/kg-day)$^{-1}$	Source	RfD (mg/kg-day)	Source	Infant RfD (mg/kg-day)		h (days)	Source	ABS	
Antimony			4.0E-03	IRIS						

Arsenic	1.5E+00	IRIS	3.0E-04	IRIS					0.03	EPA 2004
Mercury			1.0E-04	IRIS						
cPAHs (as benzo(a)pyrene	7.3E+00	IRIS	3.0E-04	IRIS					0.13	EPA 2004
Bis(2-ethylhexyl)phthalate	1.4E-02	IRIS	2.0E-02	IRIS					0.1	EPA 2004
Aldrin	1.7E+01	IRIS	3.0E-05	IRIS					0.1	EPA 2004
Dieldrin	1.6E+01	IRIS	5.0E-05	IRIS					0.1	EPA 2004
Chlordane	3.5E-01	IRIS	5.0E-04	IRIS					0.04	EPA 2004
DDx	3.4E-01	IRIS	5.0E-04	IRIS			120	ODEQ[a]	0.03	EPA 2004
Hexachlorobenzene	1.6E+00	IRIS	8.0E-04	IRIS					0.1	EPA 2004
Pentachlorophenol	4.0E-01	IRIS	5.0E-03	IRIS					0.25	EPA 2004
PCBs	2.0E+00	IRIS	2.0E-05	IRIS	3.0E-05	ODEQ	2555	ODEQ	0.14	EPA 2004
PDBEs			1.0E-04	IRIS	1.0E-04	IRIS	2555	ODEQ	0.14	EPA 2004
1,2,3,4,7,8-HxDCF	1.3E+04[b]	IRIS	7.0E-09	IRIS	7.0E-09	IRIS	2550	ODEQ	0.03	EPA 2004
1,2,3,7,8-PeCDD	1.3E+05	IRIS	7.0E-10	IRIS	7.0E-10	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,4,7,8-PeCDF	3.9E+04	IRIS	2.3E-09	IRIS	2.3E-09	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,7,8-TCDF	1.3E_04	IRIS	7.0E-09	IRIS	7.0E-09	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,7,8-TCDD	1.3E+05	IRIS	7.0E-10	IRIS	7.0E-10	IRIS	2550	ODEQ	0.03	EPA 2004

IRIS – US EPA Integrated Risk Information System www.epa.gov/iris
a – ODEQ 2010 Appdenix D
b – CSF and RfDs for congeners other than 2,3,7,8-TCDD calculated using the TEF methodology in EPA 2010

a

Table 3
Whole Body/Fillet Contaminant Ratios

	Smallmouth Bass	Carp	Black Crappie	Brown Bullhead
Aldrin[a]	5.77	1.36	12	10.46
Chlordane	5.92	1.4	12	10.46
Dieldrin	5.77	1.36	12[b]	10.46[b]
DDx[c]	7.17	1.42	6.32	4.06
PCBs	8.02	1.82	5.46	1.56
Total Dioxins/Furans	6.13	1.52	6.13	1.52

a – not measured, based on dieldrin
b – not measured, based on chlordane
c – average of DDD, DDE, and DDT

Appendix B2 - Ecological Risk-Based Preliminary Remediation Goal (PRG) Derivation

1.0 Introduction

Preliminary Remediation Goals (PRGs) in this Feasibility Study (FS) are based on risk-based toxicity reference values (TRVs) identified in the Portland Harbor Baseline Ecological Risk Assessment (BERA, Windward Environmental 2013), on the results of site-specific sediment toxicity tests presented in the BERA, and on the dietary exposures identified in the BERA. Ecological PRGs have been developed for sediment, surface water, and pore water. A summary of the ecological risk-based PRGs is presented in Table B2.

1.1 Sediment PRGs Based on Direct Exposure

Two types of sediment PRGs were developed for protection of ecological receptors via direct contact:

- PRGs expressed as dry weight (dw) contaminant concentrations in sediment.
- Empirical, site specific toxicity-based PRGs, expressed in terms of a maximum allowable percent reduction in either survival or biomass

Benthic Invertebrate PRGs

Sediment PRGs are developed for three benthic organisms: clams, crayfish, and worms. The values were derived from the benthic tissue-residue LOAEL TRVs in Table 6-27 of the BERA (Windward 2013), divided by site-specific biota-sediment accumulation regressions (BSARs) to obtain the protective sediment concentrations. Site-specific BSARs were developed and presented in Tables 4-1, 4-2, and 4-3 of the *Bioaccumulation Modeling Report* (Windward 20XX). The L2 SQV values from the BERA Table 6-11 were used for the benthic values representing the Logistic Regression Model (LRM). The PEC values in Table B2 are from McDonald et al (2000) presented in Table 6-18 of the BERA.

Tissue Residue-based PRGs

PRGs protective of fish are sediment concentrations calculated such that contaminant concentrations in whole body fish will be less than those linked to ecologically significant adverse effects directly on fish (but not secondary effects on consumers of exposed fish). BSARs were developed and presented in Tables 4-4 and 4-5 of the *Bioaccumulation Modeling Report* (Windward 20XX) for fish with small home ranges (sculpin and small mouth bass). Biota-sediment accumulation factors (BSAFs) were developed and presented in Table 4-6 of the *Bioaccumulation Modeling Report* (Windward 20XX) for large home-range fish with large home ranges (black crappie, brown bullhead, carp, lamprey, largescale sucker, northern pikeminnow, and peamouth). For those contaminants where site-specific biota-sediment accumulation factors (BSAFs) or BSARs could not identify relationships between sediment and tissue concentrations, a nationwide theoretical BSAF of 4.0 was used for hydrophobic organic chemicals (U.S. Army Corps of Engineers 2003, Appendix G).

Empirical Site Specific Sediment Toxicity Test Based PRGs.

Sediment toxicity test based TRVs are expressed as 1) the minimum allowable percent survival or 2) the minimum percent biomass relative to survival or biomass in the laboratory negative control response for each of four sediment toxicity test endpoints. Toxicity test

PRGs are applied in a single endpoint specific basis; failure to meet any one of the criteria presented below is considered indicative of unacceptable risk.

- *Chironomus dilutus* survival must be greater than 84 percent
- *Chironomus dilutus* biomass must be greater than 82 percent of control sample biomass
- *Hyalella azteca* survival must be greater than 79 percent
- *Hyalella azteca* biomass must be greater than 59 percent of control sample biomass

The PRGs for minimum allowable survival or biomass were derived from a site and toxicity test-specific approach for identifying reductions in survival or biomass greater than what would be expected at relatively contaminant-free portions of Portland Harbor. This "reference envelope" approach, is described in detail in Section 6 of the final BERA and its associated attachments. Failure to meet a toxicity test-based PRG, is defined in terms of both the absolute magnitude of the survival or biomass reduction, and the reduction must differ from the control response criterion with statistical significance.

Level 1 (low toxicity) adverse effect levels from site-specific sediment toxicity tests in the BERA were not used to derive sediment PRGs because either the percentage reduction in survival or biomass from the toxicity tests overlapped the allowable control mortality or biomass reductions in the ASTM and EPA sediment toxicity testing methodology acceptability criteria, or the Level 1 reductions in survival or biomass from control sample survival and biomass were not statistically significantly different.

Benthic risk areas were identified based on multiple lines of evidence including numerical sediment PRGs, transition zone water concentrations compared to water quality criteria for the protection of aquatic life, and site specific toxicity testing. Sediment toxicity was considered the primary line of evidence for identifying benthic risk areas, and areas where sediment PRGs were exceeded but no toxicity was observed were not included as benthic risk areas.

1.2 Sediment PRGs Based on Ingestion of Biota (prey)

Sediment PRGs protective of the BERA avian and mammalian assessment endpoints from dietary ingestion were estimated using either the Arnot and Gobas food web model as modified for Portland Harbor (Windward 2015), or the use of BSAFs. Because a multi-species diet was used to evaluate risk associated with the dietary pathway, a range of PRGs were developed. PRGs based on prey ingestion were calculated using the following general formula: .

$$PRG_{sed} = \left[\frac{\left(\frac{TRV_{dietary}}{CR} \right)}{BSAF \times f_{lipid}} \right] \times f_{oc} \times CF$$

Where:

PRG_{sed} = Preliminary remediation goal in sediment for a contaminant (µg/kg or mg/kg dry weight sediment)

$TRV_{dietary}$ = Toxicity reference value for contaminant in the diet if the target ecological receptor (mg/kg or mg/kg BW-day), where BW us the body weight of the target receptor

CR = Consumption rate of prey items (kg/day or kg/kg body weight-day)

f_{lipid} = Decimal fraction of the lipid content of prey (unitless)

BSAF = Biota-sediment accumulation factor from sediment to prey (unitless)

f_{oc} = Decimal fraction of the organic carbon content of sediment (unitless)

CF = Units conversion factor as needed

BASFs and BSARs (as appropriate) are presented in Section 4 of Windward 2015, avian and mammalian dietary TRVs are presented in Tables 8-9 and 8-10, respectively, of the final BERA (Windward 2013). PRGs were developed for chlorinated pesticides, total PCBs, and specific dioxin/furan congeners using the food web model. The target prey tissue concentration was calculated as a weighted mean based on the prey-consumption portions for each target species presented in Table 8-6 of the Final Portland Harbor BERA. Oregon human health ambient water quality criteria (DEQ 2011) for consumption of water and organism were used for the contaminant concentration in water. The goal-seek function in Excel was then used to calculate a sediment concentration that resulted in the weighted mean target tissue concentration for each species presented in Table 8-11 and 8-13 of the Final BERA, and assuming a LOAEL endpoint

1.3 Sediment PRGs for Piscivorous Bird Egg

Parental contaminant levels accumulated from the diet of birds are in turn deposited in their eggs via maternal transfer. Sediment PRGs for contaminants in bird egg tissue were calculated for PCBs, dioxins/furans, DDx and DDE. Sediment PRGs from the bird egg line of evidence in the BERA were calculated as follows:

$$PRG_{sed} = \left[\frac{\left(\dfrac{TRV_{bird\ egg\ tissue}}{BMF} \right)}{BSAF \times f_{lipid}} \right] \times f_{oc} \times CF$$

Where:

PRG_{sed} = Preliminary remediation goal in sediment for a contaminant (µg/kg or mg/kg dry weight sediment)

$TRV_{bird\ egg\ tissue}$ = Toxicity reference value for a contaminant in the eggs of the target avian receptor (mg/kg)

BMF = Prey to egg biomagnification factor (unitless)

f_{lipid} = Decimal fraction of the lipid content of prey (unitless)

BSAF = Biota-sediment accumulation factor from sediment to prey (unitless)

f_{oc} = Decimal fraction of the organic carbon content of sediment (unitless)

CF = Units conversion factor as needed

Due to the limited number of dioxin/furans analyses of fish tissue, a number of assumptions were needed to calculate the target dioxin prey- tissue concentration. Although 90 percent of the osprey diet at Portland Harbor consists of largescale sucker, pikeminnow, no tissue analyses of these species were performed for dioxin/furan congeners. Thus, dioxin concentrations in osprey prey species were extrapolated from analytical results from carp, smallmouth bass and brown bullhead. Portland Harbor fish species in the osprey diet for which dioxin tissue results are available. These three species account for 6, 2 and 2 percent of the osprey diet, respectively. Scaling these proportions 100 percent of the diet yields a diet of 60 percent carp, 20 percent bass, and 20 percent bullhead.

2.0 References

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Windward Environmental LLC. 2013. Portland Harbor RI/FS, Final Remedial Investigation Report, Appendix G. Final Baseline Ecological Risk Assessment. Prepared for the Lower Willamette Group and the U.S. Environmental Protection Agency. December 16, 2013.

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Table B-1
Risk-Based Human Health PRGs
Portland Harbor Superfund Site
Portland, Oregon

			Beach Sediment (Direct Contact)					In-water Sediment (Direct Contact)					Fish Consumption (Tissue)		Fish/Shellfish Consumption (Sediment)	
			Dockside Worker	**Transient**	**Recreational Beach User**	**High Frequency Fisher**	**Tribal Fisher**	**In-water Worker**	**High Frequency Fisher**	**Tribal Fisher**	**Diver Wet Suit**	**Diver Dry Suit**	**Subsistence Fisher HQ=child**	**Subsistence Fisher Infant**	**Subsistence Fisher**	**Subsistence Fisher Infant**
COCs	**Target Risk Level**	**Units**			HQ=child								Fillet	Fillet		
Arsenic	10^{-6}	mg/kg	4	7	0.7	1.7	0.4	54	3.8	1.0	45		0.001	NA	NA	NA
	10^{-4}	mg/kg	434	698	75	168	43	5,425	376	97	4,471		0.1	NA	NA	NA
	HQ=1	mg/kg	697	1,122	37	325	195	3,487	724	435	7,185		0.08	NA	NA	NA
Mercury	10^{-6}	mg/kg											NA	NA	NA	NA
	10^{-4}	mg/kg											NA	NA	NA	NA
	HQ=1	mg/kg											26	NA	NA	NA
Aldrin	10^{-6}	µg/kg	316	460	29	83	21	3,955	205	53	1,416		0.06	NA	2.0	NA
	10^{-4}	µg/kg	31,641	46,042	2,947	8,295	2,133	395,511	20,548	5,284	141,572		6	NA	194	NA
	HQ=1	µg/kg	57,632	83,862	1,555	18,131	10,879	288,158	44,913	26,948	257,864		7.9	NA	260	NA
Chlordanes	10^{-6}	µg/kg	18,057	28,547	2,719	6,484	1,667	225,707	14,803	3,807	152,651		3	NA	1.5	NA
	10^{-4}	µg/kg	1,805,654	2,854,749	271,939	648,385	166,728	22,570,671	1,480,315	380,652	15,265,123		288	NA	404	NA
	HQ=1	µg/kg	1,128,534	1,784,218	51,128	486,289	291,773	5,642,668	1,110,236	666,142	9,540,702		131	NA	181	NA
DDx	10^{-6}	µg/kg	19,146	30,807	3,293	7,429	1,910	239,322	16,573	4,262	197,246		3	NA	6.1	NA
	10^{-4}	µg/kg	1,914,575	3,080,699	329,319	742,891	191,029	23,932,184	1,657,320	426,168	19,724,562		296	NA	705	NA
	HQ=1	µg/kg	1,162,420	1,870,425	61,028	541,249	324,750	5,812,102	1,207,476	724,486	11,975,627		131	94	307	220
Dieldrin	10^{-6}	µg/kg	336	489	31	88	23	4,202	218	56	1,504		0.06	NA	1.8	NA
	10^{-4}	µg/kg	33,618	48,920	3,131	8,814	2,266	420,230	21,833	5,614	150,421		6	NA	19	NA
	HQ=1	µg/kg	96,053	139,770	2,591	30,218	18,131	480,263	74,855	44,913	429,773		13	NA	40	NA
1,2,3,4,7,8-HxCDF	10^{-6}	µg/kg	0.5	0.8	0.09	0.2	0.05	6.0	0.4	0.1	5		0.000077	NA	0.0003	NA
	10^{-4}	µg/kg	50	81	9	19	5	630	40	10	520		0.0077	NA	0.03	NA
	HQ=1	µg/kg	16	26	0.9	8	5	81	17	10	170		0.002	0.000059	0.007	0.00023
1,2,3,7,8-PeCDD	10^{-6}	µg/kg	0.05	0.08	0.009	0.02	0.005	0.6	0.04	0.01	0.5		0.0000077	NA	0.00001[a]	NA
	10^{-4}	µg/kg	5	8.1	0.9	1.9	0.5	63	4	1	52		0.00077	NA	0.001	NA
	HQ=1	µg/kg	1.6	2.6	0.09	0.8	0.5	8.1	1.7	1	17		0.00018	0.0000059	0.0003	0.00001[a]
2,3,4,7,8-PeCDF	10^{-6}	µg/kg	0.17	0.27	0.029	0.065	0.017	2.1	0.14	0.037	1.7		0.000026	NA	0.0004	NA
	10^{-4}	µg/kg	17	27	2.9	6.5	1.7	209	14	3.7	172		0.0026	NA	0.044	NA
	HQ=1	µg/kg	5.4	8.7	0.28	2.5	1.5	27	5.6	3.4	56		0.0006	0.000020	0.01	0.000
2,3,7,8-TCDD	10^{-6}	µg/kg	0.05	0.08	0.009	0.02	0.005	0.6	0.04	0.01	0.5		0.0000077	NA	0.0000064[a]	NA
	10^{-4}	µg/kg	5	8.1	0.9	1.9	0.5	63	4	1	52		0.00077	NA	0.00062	NA
	HQ=1	µg/kg	1.6	2.6	0.09	0.8	0.5	8.1	1.7	1	17		0.00018	0.0000059	0.00012	0.000005[a]
2,3,7,8-TCDF	10^{-6}	µg/kg	0.5	0.8	0.09	0.2	0.05	6.0	0.4	0.1	5		0.000077	NA	0.0035	NA
	10^{-4}	µg/kg	50	81	9	19	5	630	40	10	520		0.0077	NA	0.35	NA
	HQ=1	µg/kg	16	26	0.9	8	5	81	17	10	170		0.002	0.000059	0.083	0.003
Bis-2-Ethylhexylphthalate	10^{-6}	µg/kg	384,211	559,081	35,787	100,727	25,901	4,802,632	249,516	64,161			72	NA	NA	NA
	10^{-4}	µg/kg	38,421,053	55,908,096	3,578,688	10,072,697	2,590,122	480,263,158	24,951,562	6,416,116				NA	NA	NA
	HQ=1	µg/kg	38,421,053	55,908,096	1,036,382	12,087,236	7,252,342	192,105,263	29,941,874	17,965,124			5,246	NA	NA	NA
Hexachlorobenzene	10^{-6}	µg/kg	3,362	4,892	313	881	227	42,023	2,183	561	15,042		0.6	NA	0.2	NA
	10^{-4}	µg/kg	336,184	489,196	31,314	88,136	22,664	4,202,303	218,326	56,141	1,504,205		63	NA	20	NA
	HQ=1	µg/kg	1,536,842	2,236,324	41,455	483,489	290,094	7,684,211	1,197,675	718,605	6,876,367		NA	NA	NA	NA
PCBs	10^{-6}	µg/kg	2,447	3,420	190	563	145	30,583	1,435	369	8,807		0.5	NA	0.2[a]	NA
	10^{-4}	µg/kg	244,665	341,969	19,039	56,299	14,477						50	NA	20	NA
	HQ=1	µg/kg	34,952	48,853	780	9,651	5,791	174,761	24,599	14,760	125,816		5	0.25	2	0.11[a]
cPAHs	10^{-6}	µg/kg	686	967	12	162	42	8,572	411	106	2,586		0.046	NA	3,950	NA
	10^{-4}	µg/kg	68,579	96,742	1,167	16,243	4,177	857,243	41,150	10,581	258,626		4.6	NA	8,500,000	NA
	HQ=1	µg/kg	536,389	756,663	NA	152,450	91,470	2,681,945	386,218	231,731	2,022,828		NA	NA	NA	NA
Pentachlorophenol	10^{-6}	µg/kg													130	
	10^{-4}	µg/kg														
	HQ=1	µg/kg														
PBDEs	10^{-6}	µg/kg											NA	NA	NA	NA
	10^{-4}	µg/kg											NA	NA	NA	NA
	HQ=1	µg/kg	174,761		3,900	48,256	28,954	873,803	122,996	73,798	629,078		26	NA	NA	NA

Notes:
a - values are based on FWM with water = 0 ug/L (using AWQC results in negative number using the FWM

NA = not available
ND = non-detect

Table B-2
Risk-Based Ecological PRGs
Portland Harbor Superfund Site
Portland, Oregon

COCs	Target Risk Level	Units	Tissu					
			Benthic					I
			Clams	Crayfish	Worms	LRM	PEC	Sculp
Arsenic	HQ=1	mg/kg					33	
Cadmium	HQ=1	mg/kg		NA			4.98	NA
Chromium	HQ=1	mg/kg		NA			111	
Copper	HQ=1	mg/kg	NA		NA	444	149	NA
Lead	HQ=1	mg/kg		NA		196	128	
Mercury	HQ=1	mg/kg		NA		NA	1.06	
Zinc	HQ=1	mg/kg	NA	NA	NA		459	
Aldrin	HQ=1	ug/kg					40	
Chlordanes	HQ=1	ug/kg		NA			17.6	
Total DDE	HQ=1	ug/kg				359*	31	
DDx	HQ=1	ug/kg	578	2450	NA	1400	63	760
Dieldrin	HQ=1	ug/kg					62	
Dioxins/Furans (2,3,7,8-TCDD Eq)	HQ=1	ug/kg						
1,2,3,4,7,8-HxCDF	HQ=1	ug/kg						
1,2,3,7,8-PeCDD	HQ=1	ug/kg						
2,3,4,7,8-PeCDF	HQ=1	ug/kg						
2,3,7,8-TCDD	HQ=1	ug/kg						
2,3,7,8-TCDF	HQ=1	ug/kg						
Bis-2-Ethylhexylphthalate	HQ=1	ug/kg	NA		NA			400
gamma-Hexachlorocyclohexane	HQ=1	ug/kg		NA			4.99	
PCBs	HQ=1	ug/kg	2420	1370	1470	2670	676	272
Total PAHs	HQ=1	mg/kg		NA			22.8	
Total LPAHs	HQ=1	mg/kg					1.5	
Total HPAHs	HQ=1	mg/kg - %fines				150	NA	
TPH (C10 to C12 aromatic)	HQ=1	mg/kg	3.9	3.9	3.9	3.9		
TPH (C10 to C12 aliphatic)	HQ=1	mg/kg	11	11	11	11		
Tributyltin	HQ=1	mg/kg	NA	NA	24	3.08	NA	
Benthic Toxicity	Maximum allowable survival or biomass reduction		Test endpoint specific - See Footnote A, Benthic Toxicity Narrative Requirement					

* = PRG calculated from a µg/kg organic carbon (OC) sediment value normalized to a bulk sediment PRG with units of µg/kg dw using the sitewide mean sediment organic carbon content of 1.71%

Footnote A: Benthic Toxicity Narrative Requirement:
Chironomus dilutus 10-day survival: survival > 84%
Chironomus dilutus 10-day biomass: biomass > 82% of the laboratory negative control biomass
Hyalella azteca 28-day survival: survival > 79%
Hyalella azteca 28-day biomass: biomass > 66% of the laboratory negative control biomass

In addition to having survival or biomass values lower than the above PRG percentages, each individual sample with survival or biomass lower than its respective PRGs must have survival or biomass statistically significantly lower than that of the laboratory negative control sediment respons

sment				Fish Dietary Assessment									Bird Egg Assessment		Bird Dietary Assessment				
Omnivore	Piscivore		Detrivore	Invertivore			Omnivore			Piscivore		Detrivore	Piscivore		Piscivore		Omnivore		Sediment P Invertiv
Largescale Sucker	Northern Pikeminnow	Smallmouth Bass	Pacific Lamprey	Sculpin	Peamouth	Juvenile Chinook	Largescale Sucker	Carp	White Sturgeon	Northern Pikeminnow	Smallmouth Bass	Pacific Lamprey	Osprey	Bald Eagle	Osprey	Bald Eagle	Hooded Merganser	Belted Kingfisher	Spotted San
				clams worms sculpin	clams worms sculpin	clams worms multiplates	clams worms		clams worms	carp crayfish largescals sucker northern pikeminnow peamouth sculpin worms	crayfish sculpin worms		population	population	carp brown bullhead largescale sucker northern pikeminnow smallmouth bass	carp largescale sucker northern pikeminnow peamouth	clams worms peamouth sculpin		clams
				NA		NA													
				NA		NA	NA		NA	NA									NA
		NA	NA																
				NA														NA	
																			146
													2.8	1.9				11.7	420
	NA	NA																182	4,439
													0.0034	0.0034					
															22,848	61,822	6,487		3,010
															491	1,372	195		158
															4,861	13,390	1,972		2,699
															348	948	160		159
															14,252	37,682	1,172		211
NA		135																NA	
152	85.5	64											86	86	428	1,306	622	51	1,002
							NA	NA	NA										NA
				NA															

d using either a one-tailed parametric t-

	Mammal Dietary Assessment	
robing ore	Aquatic-Dependent Carnivore	
dpiper	Mink	River Otter
worms	carp crayfish sculpin smallmouth bass	clams carp crayfish sculpin smallmouth bass
NA		
139		
226		
2,849		
1,262	236	414
77	6.9	11.5
225	94	118
66	4.4	6.1
65	28.3	76
609	36	62
NA		

Table 2.1-1
Chemical-Specific ARARs for Remedial Action at the Portland Harbor Superfund Site

Medium	Regulation/Citation
Protection of surface water	Clean Water Act, 33 USC 1313 and 1314. Most recent 304(a) list, as updated up to issuance of the ROD
Protection of potential drinking water sources	Safe Drinking Water Act, 42 USC 300f, 40 CFR Part 141, Subpart O, App. A. 40 CFR Part 143
Measure of protectiveness of human health and the environment in all media	Oregon Environmental Cleanup Law ORS 465.315. Oregon Hazardous Substance Remedial Action Rules OAR 340- 122-0040(2)(a) and (c), 0115(2-6).
Protection of surface water	Water Pollution Control Act ORS 468B.048. Water Quality Standards OAR Part 340, Division 41

Criterion/Standard	Comments
Under Section 304(a), minimum criteria are developed for water quality programs established by states. Two kinds of water quality criteria are developed: one for protection of human health, and one for protection of aquatic life.	Relevant and appropriate for cleanup standards for surface water and contaminated groundwater discharging to surface water if more stringent than promulgated state criteria. Relevant and Appropriate to short-term impacts from dredging and capping if more stringent than promulgated state criteria. Relevant and Appropriate as criterion to apply to point source discharges used in implementing the remedy, if applicable.
Establishes Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) to protect human health from contaminants in drinking water.	Relevant and Appropriate as cleanup standards for groundwater and surface water at Portland Harbor, which are potential drinking water sources.
Sets standards for degree of cleanup required for hazardous substances. Establishes acceptable risk levels for human health at $1x10^{-6}$ for individual carcinogens, $1x10^{-5}$ for multiple carcinogens, and Hazard Index of 1 for noncarcinogens; and protection of ecological receptors at the individual level for threatened or endangered species and the population level for all others.	A risk-based numerical value that, when applied to site-specific conditions, will establish concentrations of hazardous substances that may remain or be managed on-site in a manner avoiding unacceptable risk.
DEQ is authorized to administer and enforce CWA program in Oregon. DEQ rules designate beneficial uses for water bodies and narrative and numeric water quality criteria necessary to protect those uses. OAR 340-041-0340 designates and defines the beneficial uses that shall be protected in the Willamette Basin.	Oregon's numeric toxics water quality standards (Tables 30 and 40) are applicable requirements as cleanup standards for surface water to the extent they are more stringent than Clean Water Act 304(a) recommended criterion. All state water quality standards, including numeric, narrative, and designated uses, are applicable requirements for any discharges to surface water from point sources and activities that may result in discharges to waters of the state, such as dredge and fill, de-watering sediments, and other remedial activities. All state water quality standards are applicable to measuring controls on contaminated groundwater discharging to the Willamette River.

Cell: E36
Comment: CDM:
I added these per Lori Cora's comments. I am not sure when to call it applicable or R&A. I Picked Applicable if it directly pertained to the generator, R&A if it was secondary (i.e. transporter).
Feel free to correct me.

Table 2.1.2
Action-Specific ARARs for Remedial Action at the Portland Harbor Superfund Site

Action	Regulation/Citation
Actions that discharge dredged or fill material into navigable waters	Clean Water Act, Section 404 and Section 404(b)(1) Guidelines, 33 USC 1344, 40 CFR Part 230
Actions that discharge pollutants to waters of U.S.	Clean Water Act, Section 402, 33 USC 1342
Actions that discharge pollutants to waters of U.S.	Clean Water Act, Section 401, 33 USC 1341, 40 CFR Section, 121.2(a)(3), (4) and (5)
Actions resulting in discharges to waters of the State of Oregon, including removal and fill activities	Water Pollution Control Act ORS 468B.048 Regulations Pertaining to NPDES Discharges OAR 340-041, 340-042
Actions resulting in discharges to waters of the State of Oregon, including removal and fill activities	Certification of Compliance with Water Quality Requirements and Standards ORS 468b.035, OAR 340-041, 340-042, 340-048
Actions resulting in discharges to waters of the State of Oregon, including removal and fill activities	Rules Governing the Issuance and Enforcement of Removal-Fill Authorizations within Waters of Oregon Including Wetlands OAR 141-085 0685 (Functions and Values), 141-085-0690(4) (CWM Ratios), 141-085-0710 (Monitoring)
Actions in federal navigation channels	River and Harbors Act, 33 USC 401 et seq. 33 CFR parts 320 to 323

Criterion/Standard	Comments
Regulates discharge of dredged and fill material into navigable waters of the United States.	Applicable to dredging, covering, capping, and designation and construction of in-water disposal sites and in-water filling activities in the Willamette River.
Regulates discharges of pollutants from point sources to waters of the U.S., and requires compliance with the standards, limitations and regulations promulgated per Sections 301, 304, 306, 307, 308 of the CWA.	Relevant and Appropriate to remedial activities that result in a discharge of pollutants from point sources to the river if more stringent than state promulgated point source requirements.
Any federally authorized activity which may result in any discharge into navigable waters requires reasonable assurance that the action will comply with applicable provisions of sections 1311, 1312, 1313, 1316, and 1317 of the Clean Water Act.	Relevant and Appropriate to implementation of the remedial action that results in a discharge to the river if more stringent than state implementation regulations.
Effluent limitations and management practices for point-source discharges into waters of the state (otherwise subject to NPDES permit but for on-site permit exemption).	Applies state water quality standards and effluent limitations to point-source discharges to the Willamette River.
Provides that federally-approved activities that may result in a discharge to waters of the State requires evaluation whether an activity may proceed and meet water quality standards with conditions, which if met, will ensure that water quality standards are met.	Applicable to implementation of the remedial action (e.g., dredging, capping, and construction of confined disposal facility) that may result in a discharge to waters of the State.
Substantive requirements for dredge and fill activities in waters of the state, including in designated Essential Indigenous Anadromous Salmonid Habitat.	Applicable to remedial action dredge and fill activities, capping, and riverbank remediation.
Section 10 prohibits the unauthorized obstruction or alteration of any navigable water. Structures or work in, above, or under navigable waters are regulated under Section 10.	Applicable requirements for how remedial actions are taken or constructed in the navigation channel.

Transportation of hazardous waste off-site	Resource Conservation and Recovery Act. 40 CFR 260, 261
Transportation of hazardous waste off-site	Resource Conservation and Recovery Act. 40 CFR 260, 262
Transportation of hazardous waste off-site	Resource Conservation and Recovery Act. 40 CFR 263
Transportation of and storage and disposal of hazardous waste off-site	Resource Conservation and Recovery Act. 40 CFR 264 and 265
Disposal of samples and remedial waste	Resource Conservation and Recovery Act. 40 CFR 268
Upland and in-water disposal of dredge material	RCRA – Solid Waste. 40 CFR 257 Subpart A
Transportation of hazardous waste off-site	Hazardous Materials Transportation Act. 49 USC §5101 et seq. 40 CFR Parts 171-177
Onsite treatment, disposal, storage of hazardous waste	Hazardous Waste and Hazardous Materials II. ORS 466.005(7) OAR 340-102-0011 - Hazardous Waste Determination
Onsite treatment, disposal, storage of hazardous waste	Hazardous Waste and Hazardous Materials II. Identification and Listing of Hazardous Waste OAR 340-101-0033
Onsite treatment, disposal, storage of non-hazardous waste	Solid Waste: General Provisions. ORS 459.005, OAR 340-093, 340-094

Establishes identification standards and definitions for material exempt from the definition of a hazardous waste.	Applicable to characterizing contaminated media or hazardous wastes generated from the action and designated for off-site or upland disposal; potentially relevant and appropriate for use in identifying acceptance criteria for confined in-water disposal.
Includes manifest, record-keeping, and other requirements applicable to generators of hazardous waste.	Applicable to remedial actions that involve the transport of hazardous materials (i.e., dredged material)
Sets forth standards for transporters of hazardous wastes, including receipt of an EPA identification number and manifesting requirements.	Relevant and appropriate for remedial actions that involve the transport of hazardous materials (i.e., dredged material).
Management standards including record keeping, requirements for particular units such as tanks or containers, and other requirements applicable to owners and operators of hazardous waste treatment, storage and disposal facilities.	Relevant and appropriate to remedial actions that involve the off-site transport of hazardous materials for storage and/or disposal (i.e., dredged material).
Places land disposal restrictions, including treatment standards and related testing, tracking and record keeping requirements on hazardous waste.	Applicable for waste generated from remedial process and analyzed samples transported off site for disposal.
Establishes criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment.	RCRA Solid Waste requirements may be relevant and appropriate to remedial actions that result in upland or in-water disposal of dredged material. Requirements for the management of solid waste landfills may be relevant and appropriate to upland disposal.
Establishes requirements for acceptance and transportation of hazardous materials by private, common, or contract carriers by motor vehicle.	Hazardous Materials Transportation Act requirements are applicable to remedial actions that involve the transport of hazardous materials (i.e., dredged material).
Defines "Hazardous Waste" and the rule contains the criteria by which anyone generating residue must determine if that residue is a hazardous waste.	Specifies substantive requirements if remedial action will involve on-site treatment, disposal, or storage of RCRA-listed or characteristic hazardous waste. (Note: off-site treatment, storage, or disposal subject to all administrative and substantive state requirements.)
Identifies additional residuals that are subject to regulation as hazardous waste under state law.	Specifies requirements if remedial action will involve on-site treatment, disposal, or storage of additional listed wastes.
Substantive Requirements for the location, design, construction, operation, and closure of solid waste management facilities.	Applicable if upland disposal facility contemplated on-site for solid, nonhazardous, waste disposal, handling, treatment, or transfer. (Note: off-site transfer, treatment, handling, or disposal subject to all administrative and substantive state requirements.)

Onsite treatment, disposal, storage of non-hazardous waste	Solid Waste: Land Disposal Sites Other than Municipal Solid Waste Landfills ORS 459.015, OAR 340-095
Actions handling PCB remediation wastes and PCB containing material	Toxic Substances Control Act, 15 USC §2601 et seq., 40 CFR Part 761.60-761.79
Risk-based limits protective of human health for air emissions associated with soil or sediment removal	Clean Air Act, 40 CFR Parts 50 and 52
Actions generating air emissions	Oregon Air Pollution Control ORS 468A et. seq., General Emissions Standards OAR 340-226
Actions generating air emissions	Fugitive Emission Requirements OAR 340-208
Actions that may affect fish and wildlife	Fish and Wildlife Coordination Act. 16 USC 662, 663 50 CFR 6.302(g)
Presence of protected species	ODFW Fish Management Plans for the Willamette River. OAR 635, div 500
Actions that may affect marine mammals	Marine Mammal Protection Act. 16 USC §1361 et seq. 50 CFR 216
Actions that may affect migratory birds	Migratory Bird Treaty Act. 16 USC §703 50 CFR §10.12

Requirements for the management of solid wastes at land disposal sites other than municipal solid waste landfills.	Applicable to the on-site management and disposal of contaminated sediment, soil, and/or groundwater.
Establishes requirements for handling, storage, and disposal of PCB-containing materials, including PCB remediation wastes, and sets performance standards for disposal technologies for materials/wastes with concentrations in excess of 50 mg/kg. Establishes decontamination standards for PCB contaminated debris.	TSCA requirements are applicable to the handling of contaminated material, debris, or surface water with PCB contamination.
Air emissions from stationary and mobile sources that may be generated that creates threats to human health as defined in the regulations.	Relevant and Appropriate to remedial activities that generate air emissions.
DEQ is authorized to administer and enforce Clean Air program in Oregon. Rules provide general emission standards for fugitive emissions of air contaminants and require highest and best practicable treatment or control of such emissions.	Applicable to remedial actions taking place in on-site uplands. Could apply to earth-moving equipment, dust from vehicle traffic, and mobile-source exhaust, among other things.
Prohibits any handling, transporting, or storage of materials, or use of a road, or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. These rules for "special control areas" or other areas where fugitive emissions may cause nuisance and control measures are practicable.	Applicable to remedial actions taking place in on-site uplands. Could apply to earth-moving equipment, dust from vehicle traffic, and mobile-source exhaust, among other things.
Requires federal agencies to consider effects on fish and wildlife from projects that may alter a body of water and mitigate or compensate for project-related losses, which includes discharges of pollutants to water bodies.	Potentially applicable to determining impacts and appropriate mitigation, if necessary, for effects on fish and wildlife from filling activities or discharges from point sources.
Provides basis for in-water work windows in the Willamette River.	Potentially applicable to timing of implementation of the remedial action due to presence of protected species at the site.
Imposes restrictions on the taking, possession, transportation, selling, offering for sale, and importing of marine mammals.	Applicable to remedial actions that have the potential to affect marine mammals.
Makes it unlawful to take any migratory bird. "Take" is defined as pursuing, hunting, wounding, killing, capturing, trapping and collecting.	Applicable to remedial actions that have the potential to effect a taking of migratory birds.

Table 2.1-3
Location-Specific ARARs for Remedial Action at the Portland Harbor Superfund Site

Location	Regulation/Citation
Presence of archaeologically or historically sensitive area	Native American Graves Protection and Reparation Act, 25 USC 3001-3013, 43 CFR 10
Presence of archaeologically or historically sensitive area	Indian Graves and Protected Objects ORS 97.740-760
Presence of archaeologically or historically sensitive area	Archaeological Objects and Sites ORS 358.905- 955 ORS 390.235
Presence of archaeologically or historically sensitive area	National Historic Preservation Act. 16 USC 470 et seq. 36 CFR Part 800
Presence of archaeologically or historically sensitive area	Archaeological and Historic Preservation Act. 16 USC 469a-1
Presence of floodplain as designated on map	44 CFR 60.3(d)(2) and (3)
Presence of floodplain as designated on map	Federal Emergency Management Act, Exec. Order 11988 (1977) 40 CFR Part 6, App. A 40 CFR 6.302 (b)

Criterion/Standard	Comments
Requires Federal agencies and museums which have possession of or control over Native American cultural items (including human remains, associated and unassociated funerary items, sacred objects and objects of cultural patrimony) to compile an inventory of such items. Prescribes when such Federal agencies and museums must return Native American cultural items. "Museums" are defined as any institution or State or local government agency that receives Federal funds and has possession of, or control over, Native American cultural items.	If Native American cultural items are present on property belonging to the Oregon Division of State Lands (DSL) that is a part of the response action area, this requirement is potentially applicable. If Native American cultural items are collected by an entity which is either a federal agency or museum, then the requirements of the law are potentially applicable.
Prohibits willful removal of cairn, burial, human remains, funerary object, sacred object or object of cultural patrimony. Provides for re-interment of human remains or funerary objects under the supervision of the appropriate Indian tribe. Proposed excavation by a professional archaeologist of a native Indian cairn or burial requires written notification to the State Historic Preservation Officer and prior written consent of the appropriate Indian tribe. Prohibits persons from excavating, injuring, destroying or damaging archaeological sites or objects on public or private lands unless authorized.	Potentially relevant and appropriate if archaeological material is encountered.
Imposes conditions for excavation or removal of archaeological or historical materials.	Potentially relevant and appropriate if archaeological material encountered.
Requires the identification of historic properties potentially affected by the agency undertaking, and assessment of the effects on the historic property and seek ways to avoid, minimize or mitigate such effects. Historic property is any district, site, building, structure, or object included in or eligible for the National Register of Historic Places, including artifacts, records, and material remains related to such a property.	Potentially applicable if historic properties are potentially affected by remedial activities.
Provides for the preservation of historical and archaeological data that may be irreparably lost as a result of a federally-approved project and mandates only preservation of the data	Potentially applicable if historical and archaeological data may be irreparably lost by implementation of the remedial activities.
Prohibits encroachments that would result in any increase in flood levels during occurrence of base flood discharge.	FEMA flood rise requirements are considered relevant and appropriate requirements for remedial actions.
Requirements for Flood Plain Management Regulations Areas Requires measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains.	Relevant and appropriate for assessing impacts, if any, to the floodplain and flood storage from the response action and developing compensatory mitigation that is beneficial to floodplain values.

Presence of floodplain as designated on map	National Flood Insurance Act and Flood Disaster Protection Act. Executive Order for Floodplain Management, 42 USC 4001 et seq. 44 CFR National Flood Insurance Program Subpart A
Presence of wetlands	Executive Order for Wetlands Protection. Executive Order 11990 (1977) 40 CFR 6.302 (a) 40 CFR Part 6, App. A
Presence of state-listed threatened or endangered wildlife species	Protection and Conservation Programs ORS. 496.171 to 496.182. Survival Guidelines OAR 635-100-0135
Presence of essential fish habitat	Magnuson-Stevens Fishery Conservation and Management Act. 50 CFR Part.600.920
Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 or critical habitat of such species listed in 50 CFR 17.95	Endangered Species Act. 16 USC 1531 et seq. 50 CFR 17

Requirements for Flood Plain Management Regulations Areas requires measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains.	Relevant and appropriate for assessing impacts, if any, to the floodplain and flood storage from the response action and developing compensatory mitigation that is beneficial to floodplain values.
Requires measures to avoid adversely impacting wetlands whenever possible, minimize wetland destruction, and preserve the value of wetlands.	Relevant and appropriate in assessing impacts to wetlands, if any, from the response action and for developing appropriate compensatory mitigation for the project.
Survival Guidelines are rules for state agency actions affecting species listed under Oregon's Threatened or Endangered Wildlife Species law.	Substantive requirements of Survival Guidelines relevant and appropriate to remedial activities affecting state-listed species.
Evaluation of impacts to Essential Fish Habitat (EFH) is necessary for activities that may adversely affect EFH.	Potentially applicable if the removal action may adversely affect EFH.
Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species or result in the adverse modification of species' critical habitat. Agencies are to avoid jeopardy or take appropriate mitigation measures to avoid jeopardy.	Applicable to remedial actions that may adversely impact endangered or threatened species or critical habitat that are present at the site.

Table 2.1-4
Numeric Standards Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

Media		Surface Water and Contaminated Groundwater Discharging to Surface Water										Groundwater		Sediment	
Regulation		Clean Water Act, 33 USC 1313 and1314, Section 304(a) List						Oregon Water Pollution Control Act ORS 468B.048				Safe Drinking Water Act 42 USC 300f, 40 CFR Part 141, 143	Oregon Environmental Cleanup Law ORS 465.315	Guidance for Assessing Bioaccumulative Chemicals in Sediment	
Receptor Scenario		EPA AWQC CMC (acute)	EPA AWQC CCC (chronic)	EPA AWQC (Current) (organisms only)	EPA AWQC (Current) (water+organisms)	EPA AWQC (2014 Draft Update) (organisms only)	EPA AWQC (2014 Draft Update) (water+organisms)	DEQ's AWQC CMC (acute)	DEQ's AWQC CCC (chronic)	DEQ's 2014 AWQC (organism only)	DEQ 2014 AWQC (water + organism)	MCL	RBC - Residential	DEQ 2007 Bioaccumulative Sediment SLVs [o]	
Consumption Rate				17.5 g/day consumption rate	17.5 g/day consumption rate	22 g/day consumption rate	22 g/day consumption rate			175 g/day consumption rate	175 g/day consumption rate				
	CAS #	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/kg	
Metals/Inorganics															
Arsenic	7440-38-2	340 [a]	150 [a]	0.14	0.018	NC	NC	340 [a]	150 [a]	2.1	2.1	10	0.038	7,000	
Cadmium	7440-43-9	2 [a,b]	0.25 [a,b]					h	i,j			5	18	1,000	
Chromium, total	7440-47-3	570 [a,b]	74 [a,b]					i,j	i,j			100	55,000		
Chromium, hexavalent															
Copper	7440-50-8	c	c		1,300	NC	NC	h	h	NA	1300	1,300 = TT	1,500		
Lead	7439-92-1	65 [a,b]	2.5 [a,b]					i,j	i,j			15 = TT	15	17,000	
Manganese	7439-96-5			100	50	NC	NC			100		50 [f]	880		
Mercury	7439-97-6	1.4 [a]	0.77 [a]					2.4	0.012			2	11	70	0.3
Vanadium	7440-62-2														
Vanadium															
Zinc	7440-66-6	120 [a,b]	120 [a,b]	26,000	7,400	NC	NC	i,j	i,j	2,600	2,100	5,000 [f]			
Cyanide	57-12-5	22 [d]	5.2 [d]	140	140	400	3	22 [d]	5.2 [d]	130	130	200	22		
Perchlorate	14797-73-0														
Perchlorate															
Butyltins															
Tributyltin	56573-85-4	0.46	0.072					0.46	0.063					2.3	3.84
PCBs Aroclors															
Total PCBs			0.014	6.4E-05	6.4E-05	NC	NC	2	0.014	6.4E-06	6.4E-06	0.5		p	5.58
Chlorinated Herbicides															
2,4-D	94-75-7				100	800	200				100	70			2.81
2,4,5-TP (Silvex)	93-72-1				10	10	10				10	50			
MCPP	93-65-2														
MCPP															
Organochlorine Pesticides															
γ - BHC (Lindane)	58-89-9	0.95		1.8	0.98	2.8	2.5	0.95	0.08	0.18	0.17	0.2			3.73
Aldrin	309-00-2	3		5.0E-05	4.9E-05	1.0E-06	1.0E-06	3		5.0E-06	5.0E-06		0.00077		6.5
Chlordane (total)	57-74-9	2.4	0.0043	8.1E-04	8.0E-04	6.8E-06	6.8E-06	2.4	0.0043	8.1E-05	8.1E-05	2	0.037	0.5	6.32 [21]
DDE															
DDT - total [****]	50-29-3	1.1 [m]	0.001 [m]	0.00022 [m]	0.00022 [m]	7.2E-06	7.2E-06	1.1 [m]	0.001 [m]	0.000022 [m]	0.000022 [m]		0.17	0.39	
Dieldrin	60-57-1	0.24	0.056	5.4E-05	5.2E-05	1.0E-05	1.0E-05	0.24	0.056	5.4E-06	5.3E-06			2.2	5.37
Volatile Organic Compounds								Note: "Guidance" Values Below							
1,1- Dichloroethene	75-34-4			7,100	330	4,000	200	11,600 [k]		710	230	7	340		1.79
1,1,1- Trichloroethane (TCA)	71-55-6					100,000	10,000	18,000 [l]				200	9,100		2.48
Benzene	71-43-2			51	2.2	6.2-23	0.45-1.6	5,300		1.4	0.44	5	0.39		2.13
Chlorobenzene	108-90-87			1,600	130	600	90	250	50	160	74	100	91		
Chloroform	67-66-3			470	5.7	1,000	50	28,900	1,240	1,100	260		0.19		1.92
cis-1,2-Dichloroethlyene	156-59-2							11,600 [k]				70	73		1.86
Ethylbenzene	100-41-4			2,100	530	1,000	400	32,000		210	160	700	1.4		3.14
m- and p-Xylene												10000 [g]	200 [g]		3.2,3.17
o-Xylene (and Total Xylenes)	95-47-6											10000 [g]	200 [g]		3.13
Tetrachloroethene (PCE)	127-18-4			3.3	0.69	40	10	5,280	840	0.33	0.24	5	11		2.88
Toluene	108-88-3			15,000	1,300	2,000	300	17,500		1,500	720	1,000	2,300		2.75
Trichloroethene (TCE)	79-01-6			30	2.5	4	0.5	45,000	21,900	3	1.4	5	0.43		2.71 [26]
Vinyl Chloride	75-01-4			2.4	0.025	0.68	0.018			0.24	0.023	2	0.025		1.5
Semivolatile Organic Compounds															
Halogenated Compounds								Note: "Guidance" Values Below							
1,2-Dichlorobenzene	95-50-1			1,300	420	1,000	700	1120 [n]	763 [n]	130	110	600	370		3.43
Hexachlorobenzene	118-74-1			2.9E-04	2.8E-04	6.4E-06	6.4E-06			2.9E-05	2.9E-05	1	0.0081	61,000	5.89
PBDEs															
Phenols and Substituted Phenols															
Pentachlorophenol	87-86-5	19 [e]	15 [e]	3.0	0.27	0.02	0.02	19 [e]	15 [e]	0.3	0.15	1	0.14	0.31	5.05
Phthalate Esters															
bis(2-Ethylhexyl)phthalate	117-81-7			2.2	1.2	0.029	0.028			0.22	0.20	6	4.1	330	7.3
Hydrocarbons															
Benzo(a)pyrene (equivalents)	50-32-8			1.8E-02	3.8E-03	8.4E-04	7.7E-04			0.0018	0.0013	0.2	0.0029		6.11
Total PAH															
Total LPAH															
Total HPAH															
TPH (C-10-C-12 Aliphatic/aromatic)													110		
Chlorinated Dioxins and Furans								Note: "Guidance" Values Below							
2,3,7,8,-TCDD (Toxicity Equivalence Quotient)	1746-01-6			5.1E-09	5.0E-09	NC	NC	1.0E-02	3.8E-05	5.1E-10	5.1E-10	0.00003	7.6E-08	5.6E-04	
Toxicity															
Benthic Toxicity															

Acronyms
ARARs - Applicable or relevant and appropriate requirements
AWQC - Ambient Water Quality Criteria (Human Health Based)
WQC - Water Quality Criteria (Aquatic Life Protection)
CCC - Criterion Continous Concentration
CMC - Criteria Maximum Concentration
NC - no change
MCL - Maximum Contaminant Level
SLVs - Screening Level Values
N/A - not available
TT - Treatment technique. A required process intended to reduce the level of a contaminant in drinking water
µg/l - micrograms per liter
µg/kg -micrograms per kilogram

Notes
a - expressed in terms of dissolved metal in the water column
b - expressed as a function of hardness (mg/L) in the water column. The value given corresponds to a hardness of 100 mg/kg.
c - Requires calculation by the BLM (biotic ligand model) that uses receiving water characteristics to develop site-specific water quality criteria.
d - expressed as free cyanide
e - expressed as a function of pH. Value corresponds to a pH of 7.8
f - secondary standard
g - total xylenes
h - expressed as total recoverable as a function of hardness (mg/L) in the water column. Requires calculation using formula provided.
i - expressed as a function of hardness (mg/L). Requires calculation using formula provided.
j - expressed in terms of dissolved concentration.
k - total dichlorothenes
l - total trichlorinated ethanes
m - based on 4,4-DDT
n - total dichlorobenzenes
o - based on risk to Fish. µg/kg dry weight in sediment
p - based on specific congeners. For fish the SLVs range from 6.5 to 430 µg/kg.

**** - There are different values for DDT, DDE and DDD. It does not simply say total DDT. I used 4,4-DDT, but DDE may be more stringent Use lowst? Add all or just note this specific to that DDT? Or go with lowest?

Table 3-1 7/16/07 Revision

Table 3-1b Screening Level Values for Soil/Stormwater Sediment, Stormwater, Groundwater, and Surface Water (A)
[Only chemicals not identified as COC and for which PRGs were developed]

Chemical		GROUNDWATER / SURFACE W		
		Human Hea		
		Fish Consumption		
		EPA's 2004 NRWQC (organism only)	Portland Harbor specific fish consumption rate	DEQ's 2004 AWQC (organism only)
		17.5 g/day consumption rate	175 g/day consumption rate	17.5 g/day consumption rate
Units		µg/l	µg/l	µg/l
NOTE: Numbers highlighted in yellow are values to be used for initial upland source control screening evaluations for water.				
Metals/Inorganics	CAS #	Metals in these columns are expressed as dissolved metal in the water column except where noted		Metals in these col in terms of total reco water c
Aluminum (pH 6.5 - 9.0)(13)	7429-90-5			
Antimony	7440-36-0	640	64	640
Arsenic III	22569-72-8			
Nickel(15)	7440-02-0	4,600	460	4,600
Selenium	7782-49-2	4,200	420	4,200
Silver (15)	7440-22-4			
Butyltins 12				
Dibutyltin	1002-53-5			

ATER / STORMWATER			GROUNDWATER / SURFACE WATER / STORMWATER		
Water [C]					
lth #			Ecological Receptors #		
	Drinking Water				
Portland Harbor specific fish consumption rate 175 g/day consumption rate	MCL	Tap Water PRGs	EPA's 2004 NRWQC (chronic)	DEQ's 2004 AWQC (chronic)	Oak Ridge National Laboratory's (Tier II SCV)[j]
µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
umns are expressed overable metal in the coulmn			Metals in this column are expressed as dissolved metal in the water column except where noted	Metals in this column are expressed in terms of total recoverable metal in the water coulmn	
	(50-200)[29]	37,000	87		
64	**6**	15		1600 (16)	30
				190 (14)	
460		730	**16**	49 (14)	
420	50	180	**5 (19)**	35 (14)	
	(100)[29]	180		**0.12 (14)**	0.36

UPLAND SOIL / STORMWATER SEDIMENT [D]		
Soil/Stormwater Sediment[D]		
Toxicity	Bioaccumulation	Log K_{ow} [20]
MacDonald PECs and other SQVs [1]	DEQ 2007 Bioaccumulative Sediment SLVs [E]	
µg/kg	µg/kg	
NOTE: Numbers highlighted in orange are to be used for initial upland source control screening evaluations for soil and stormwater sediment.		
64,000 [3]		
48,600 [2]		
5,000 [4]	**2000 [31]**	
5,000 [5, 4]		
		0.41

Monobutyltin	78763-54-9			
Tetrabutyltin	1461-25-2			
PCBs Aroclors				
Aroclor 1016	12674-11-2			
Aroclor 1221	11104-28-2			
Aroclor 1232	11141-16-5			
Aroclor 1242				
Aroclor 1248	12672-29-6			
Aroclor 1254	11097-69-1			
Aroclor 1260	11096-82-5			
Aroclor 1262	37324-23-5			
Aroclor 1268	11100-14-4			
PCB Congeners				
All 209 PCB congener target analytes				
3,3',4,4'-TCB	32598-13-3			
3,4,4',5-TCB				
2,3,3',4,4'-PeCB	32598-14-4			
2,3,4,4',5-PeCB				
2,3',4,4',5-PeCB	31508-00-6			
2',3,4,4',5-PeCB				
3,3',4,4',5-PeCB				
2,3,3',4,4',5'-HxCB				
2,3,3',4,4',5-HxCB				
2,3',4,4',5,5'-HxCB				
3,3',4,4',5,5'-HxCB	32774-16-6			
2,3,3',4,4',5,5'-HpCB				
Chlorinated Herbicides				
2,4,5-T	93-76-5			
2,4-DB	94-82-6			
Dalapon	75-99-0			
Dicamba	1918-00-9			
Dichlorprop	120-36-5			
Dinoseb	88-85-7			
MCPA	94-74-6			
MCPP	93-65-2			
Organochlorine Pesticides				
cis - nonachlor	5103-73-1			
DDD (34)	72-54-8	**0.00031**	0.000031	0.00031
DDE (34)	72-55-9	**0.00022**	0.000022	0.00022
DDT (34)	50-29-3	**0.00022**	0.000022	0.00022
Endosulfan alpha-	959-98-8	89	8.9	89

		0.96			
		0.034			0.28
		0.034			0.58
		0.034			0.053
		0.034			0.081
		0.034			**0.033**
		0.034			94

		370			
		290			
	200	1,100			
		1,100			
		370			
	7	37			
		18			
		37			

		0.19			
0.000031		0.28			0.011[(d)]
0.000022		0.2			
0.000022		0.2	0.001	0.001	0.013[(e)]
8.9		220	0.056	0.056	**0.051**

		1.89
		9.37
530[9]		4.4 - 5.8
		4.1 - 4.7
		4.5 - 5.2
		4.5 - 5.8
1,500[9]		5.8 - 6.3
300[9]		6.1 - 6.8
200[9]		6.3 - 7.5
		5.58
		5.58
		4.3 - 8.26
	0.052[33]	
	0.017[33]	
	0.17[33]	
	0.17[33]	
	0.12[33]	
	0.21[33]	
	0.00005[33]	
	0.21[33]	
	0.21[33]	
	0.21[33]	
	0.00021[33]	
	1.2[33]	
		0.78
		2.21
		2.69
		3.43
		3.13
		3.53
		3.56
		3.8
28[2]	0.33	3.81
31.3[2]	0.33	4.14
62.9[2]	0.33	6.26
		5

Endosulfan beta-	33213-65-9	89	8.9	89
Endosulfan sulfate	1031-07-8	**89**	8.9	89
Endrin	72-20-8	0.06	0.006	0.06
Endrin aldehyde	7421-93-4	0.3	0.03	0.3
Endrin ketone	53494-70-5			
Heptachlor	76-44-8	**0.000079**	0.0000079	0.000079
Heptachlor epoxide	102-45-73	**0.000039**	0.0000039	0.000039
Methoxychlor	72-43-5			
oxy chlordane				
Toxaphene	8001-35-2	0.00028	0.000028	0.00028
trans - nonachlor	39765-80-5			
α - BHC	319-84-6	**0.0049**	0.00049	0.0049
β - BHC	319-85-7	**0.017**	0.0017	0.017
δ - BHC	319-86-8			
Volatile Organic Compounds				
1,1,1,2- Tetrachloroethane	630-20-6			
1,1,2- Trichloroethane	79-00-5	16	1.6	16
1,1,2,2- Tetrachloroethane	79-34-5	4	0.4	4
1,2- Dibromoethane (EDB)	106-93-4			
1,2- Dichloroethane (EDC)	107-06-2	37	3.7	37
1,2- Dichloropropane	78-87-5	15	1.5	15
1,2,3- Trichloropropane	96-18-4			
2- Butanone (MEK)	78-93-3			
2- Chloroethyl Vinyl Ether	110-75-8			
2- Hexanone	591-78-6			
4- Methyl-2-Pentanone (MIBK)	108-10-1			
Acetone	67-64-1			
Acrolein	107-02-8	290	29	290
Acrylonitrile	107-13-1	0.25	0.025	0.25
Bromochloromethane	74-97-5			
Bromodichloromethane	75-27-4			
Bromoform	75-25-2	140	14	140
Bromomethane	74-83-9			
Carbon Disulfide	75-15-0			
Carbon Tetrachloride	56-23-5	1.6	0.16	1.6
Chlorodibromomethane	124-48-1	13	1.3	13
Chloroethane	75-00-3			
Chloromethane	74-87-3			
cis-1,3-Dichloropropene	10061-01-5			
Dibromomethane	74-95-3			
Dichlorodifluoromethane	75-71-8			
Iodomethane (Methyl Iodide)	74-88-4			
Isopropylbenzene	98-82-8			
Methylene chloride	75-09-2	590	59	590

8.9		220	0.056	0.056	**0.051**
8.9					
0.006	2	11	**0.036**	0.0023 (14)	0.061
0.03					
0.0000079	0.4	0.015	0.0038	0.0038	0.0069
0.0000039	0.2	0.0074	0.0038	0.0038	
	40	180	**0.03**	0.03	0.019
		0.19			
0.000028	3	0.061	**0.0002**	0.0002	
		0.19			
0.00049		0.011			2.2(c)
0.0017		0.037			
		0.037			

		2.5			
1.6	5	**1.2**		9,400 (16)	**1,200**
0.4		**0.33**		2,400 (16)	**610**
		0.033			
3.7	5	**0.73**		20,000 (16)	910
1.5	5	**0.97**			
		0.0095			
		7,100			14,000
					99
		2000			**170**
		5,500			**1,500**
29		**0.042**		21 (16)	
0.025		**0.12**		2,600 (16)	
		1.1			
14		**8.5**			
		8.7			
		1,000			**0.92**
0.16	5	**0.51**			9.8
1.3		**0.79**			
		23			
		2.1			
					0.055
		61			
		390			
		660			
59		**8.9**			2,200

		4.1[22]	
		4.1[22]	
207 [2]		4.1[22]	
		6.76	
		6.1	
10 [6]		6.53	
16 [2]		5.06	
		5.06	
		5.06	
		5.08	
		5.5	
		6.32	
		6.32[21]	
		6.32[21]	
		2.39	
		2.05	
		2.63	
		1.47	
		1.97	
		1.28	
		1.38	
		-0.024	
		-0.01	
		1.41	
		2.1	
		2.35	
		1.19	
		2	
		2.73	
		2.17	
		1.43	
		0.91	
		2	
		2.3	
		2.16	
		1.5	
		3.63	
		1.25	

Methyltert-butyl ether	1634-04-4			
Styrene	100-42-5			
trans-1,3-Dichloropropene	10061-02-6			
trans-1,4-Dichloro-2-butene	110-57-6			
Trichlorofluoromethane	75-69-4			
Vinyl Acetate	108-05-4			
Semivolatile Organic Compounds				
Halogenated Compounds				
1,2,4-Trichlorobenzene	120-82-1	70	7	70
1,3-Dichlorobenzene	541-73-1	960	96	960
1,4-Dichlorobenzene	106-46-7	190	19	190
2,2'-oxybis(1-chloropropane)	108-60-1			
2-Chloronaphthalene	91-58-7	1,600	160	1,600
3,3'-Dichlorobenzidine	91-94-1	**0.028**	0.0028	0.028
4-bromophenyl-phenyl ether	101-55-3			
4-Chloroaniline	106-47-8			
4-Chlorophenyl-phenyl ether	7005-72-3			
Bis-(2-chloroethoxy) methane	111-91-1			
Bis-(2-chloroethyl) ether	111-44-4	0.53	0.053	0.53
Hexachlorobutadiene	87-68-3	18	1.8	18
Hexachlorocyclopentadiene	77-47-4	1,100	110	1,100
Hexachloroethane	67-72-1	**3.3**	0.33	3.3
Organonitrogen Compounds				
2,4-Dinitrotoluene	121-14-2	**3.4**	0.34	3.4
2,6-Dinitrotoluene	606-20-2			
2-Nitroaniline	88-74-4			
3-Nitroaniline	99-09-2			
4-Nitroaniline	100-01-6			
Aniline	62-53-3			
Carbazole	86-74-8			
Nitrobenzene	98-95-3	690	69	690
N-Nitrosodimethylamine	62-75-9	3	0.3	3
N-Nitroso-di-n-propylamine	621-64-7	0.51	0.051	0.51
N-Nitrosodiphenylamine	86-30-6	**6**	0.6	6
Oxygen-Containing Compounds				
Benzoic Acid	65-85-0			
Benzyl Alcohol	100-51-6			
Dibenzofuran	132-64-9			
Isophorone	78-59-1	960	96	960
Phenols and Substituted Phenols				
2,3,4,6-Tetrachlorophenol	58-90-2			

		37			
	100	1,600			
		0.4			**0.055**
		7100			
		1,300			
		410			**16**

7	70	**8.2**			110
96		**14**		763 (16)	71
19	75	**2.8**		763 (16)	15
		0.95			
160		**490**			
0.0028		0.15		763 (16)	
		150			
		0.06			
0.053		**0.06**			
1.8		**0.86**		9.3 (16)	
110	50	220		**5.2 (16)**	
0.33		4.8		540 (16)	12

0.34		73			
		37			
		110.0			
		3.2			
		3.2			
		12			
		3.4			
69		**3.4**			
0.3		**0.00042**			
0.051		**0.0096**			
0.6		14			210

		150,000			**42**
		11,000			**8.6**
		12			**3.7**
96		**71**			

		1,100			

		2.94	
		2.53	
		0.73	
		2.0[25]	
9,200 [7]		3.4	
300 [7]		3.42	
300 [7]		4.01	
		4	
		4.81	
		5.39	
		1.21	
		4.08	
600 [8]		4.28	
400 [8]		3.51	
		1.85	
		1.84	
		0.9	
		1.78	
		1.31	
		-0.57	
1,600 [5]		1.31	
		3.13	
		2.01	
		1.87	
		3.59	
		1.89	
		1.1	
		4.31	
		1.7	
		1.48	

2,4,5-Trichlorophenol	95-95-4	**3,600 (24)**	360 (24)	3,600
2,4,6-trichlorophenol	88-06-2	**2.4**	0.24	2.4
2,4-Dichlorophenol	120-83-2	290	29	290
2,4-Dimethylphenol	105-67-9	850	85	850
2,4-Dinitrophenol	51-28-5	5,300	530	5,300
2-Chlorophenol	95-57-8	150	15	150
2-Methylphenol (o-Cresol)	95-48-7			
2-Nitrophenol	88-75-5			
4-Chloro-3-methylphenol	59-50-7			
4-Methylphenol (p-Cresol)	106-44-5			
4-Nitrophenol	100-02-7			
Methyl-4,6-Dinitrophenol 2-	534-52-1	280	28	280
Phenol	108-95-2	1,700,000	170,000	1,700,000
Phthalate Esters				
Butylbenzylphthalate	85-68-7	1900	190	1900
Diethylphthalate	84-66-2	44,000	4,400	44,000
Dimethylphthalate	131-11-3	1,100,000	110,000	1,100,000
Di-n-butylphthalate	84-74-2	4,500	450	4,500
Di-n-octylphthalate	117-84-0			
Polycyclic Aromatic Hydrocarbons				
2-Methylnaphthalene	91-57-6			
Acenaphthene	83-32-9	990	99	990
Acenaphthylene	208-96-8			
Anthracene	120-12-7	40,000	4,000	40,000
Benzo(a)anthracene	56-55-3	**0.018**	0.0018	0.018
Benzo(b)fluoranthene	205-99-2	**0.018**	0.0018	0.018
Benzo(g,h,i)perylene	191-24-2			
Benzo(k)fluoranthene	207-08-9	**0.018**	0.0018	0.018
Chrysene	218-01-9	**0.018**	0.0018	0.018
Dibenz(a,h)anthracene	53-70-3	**0.018**	0.0018	0.018
Fluoranthene	206-44-0	140	14	140
Fluorene	86-73-7	5,300	530	5,300
Indeno(1,2,3-cd)pyrene	193-39-5	**0.018**	0.0018	0.018
Naphthalene	91-20-3			
Phenanthrene	85-01-8			
Pyrene	129-00-0	4,000	400	4,000
Chlorinated Dioxins and Furans				
2,3,7,8,-TCDD	1746-01-6	**5.1E-09**	5.1E-10	5.1E-09
2,3,7,8,-TCDF				

360		3,700			
0.24		6.1		970 (16)	
29		**110**		365 (16)	
85		**730**			
530		**73**		150 (16)	
15		**30**		2,000 (16)	
		1,800			**13**
		1100		**150 (16)**	
		180			
		290		**150 (16)**	300
28				**150 (16)**	
170,000		11,000		**2,560 (16)**	

190		7,300		**3 (16)**	19
4,400		29,000		**3 (16)**	210
110,000		370,000		**3 (16)**	
450		3,700		**3 (16)**	
		1,500		**3 (16)**	

	0.2 (26)				2.1(h)
99	**0.2 (26)**	370		520 (16)	
	0.2 (26)				
4,000	**0.2 (26)**	1,800			0.73
0.0018	0.2 (26)	0.092			0.027
0.0018	0.2 (26)	0.092			
	0.2 (26)				
0.0018	0.2 (26)	0.92			
0.0018	0.2 (26)	9.2			
0.0018	0.2 (26)	0.0092			
14	**0.2 (26)**	1,500			
530	**0.2 (26)**	240			3.9
0.0018	0.2 (26)	0.092			
	0.2 (26)	6.2		620 (16)	12
	0.2 (26)				
400	**0.2 (26)**	180			

5.1E-10		4.5E-07		0.00038 (16)	

		1.99	
		1.96	
		2.36	
		2.17	
		3.2	
		3.72	
		3.69	
		4.45	
		1.8	
		1.91	
		1.67	
50 [5, 6]			
		2.12	
600 [7]		2.5	
		4.61	
100 [6]	60	4.84	
		8.06	
200 [11]		3.36	
300 [6]		3.86	
200 [6]		4.0	
845 [2]		3.92	
1,050 [2]		4.21	
		4.57	
300 [16]		4.55	
13,000 [6]		5.12	
1,290 [2]		5.11	
1,300 [9]		5.7	
2,230 [2]	37000 [32]	5.7	
536 [2]		6.2	
100 [10]		6.2	
561 [2]		6.65	
1,170 [2]		6.69	
1,520 [2]	1900 [32]	6.5	
0.009 [6]	0.0000091 [33]	6.8	
	0.00077 [33]	6.1	

1,2,3,7,8,-PeCDD				
1,2,3,7,8,-PeCDF				
2,3,4,7,8,-PeCDF				
2,3,4,7,8,-PeCDF				
1,2,3,6,7,8,-HxCDD				
1,2,3,7,8,9,-HxCDD				
1,2,3,4,7,8,-HxCDF				
1,2,3,6,7,8,-HxCDF				
1,2,3,7,8,9,-HxCDF				
2,3,4,6,7,8,-HxCDF				
1,2,3,4,6,7,8,-HpCDD				
1,2,3,4,6,7,8,-HpCDF				
1,2,3,4,7,8,9,-HpCDF				
OCDD	3268-87-9			
OCDF	39001-02-0			
Total tetrachlorinated dioxins				
Total pentachlorinated dioxins				
Total hexachlorinated dioxins				
Total heptachlorinated dioxins				
Total tetrachlorinated furans				
Total pentachlorinated furans				
Total hexachlorinated furans				
Total heptachlorinated furans				

	0.0026 [33]	7.4	
	0.0026 [33]	6.5	
	0.00003 [33]	6.5	
		7.8	
		7.8	
		7.8	
	0.0027 [33]	7	
	0.0027 [33]		
	0.0027 [33]		
	0.0027 [33]		
	0.69 [33]	8	
	0.69 [33]	7.4	
	0.69 [33]		
	23 [33]	8.2	
	23 [33]	8	

Notes:

[A] Stormwater values in this table are intended for screening non-permitted discharges.

[C] EPA, under CERCLA authority, has identified the Sage Drinking Water Act's MCLs and AWQCs (federal and state, once ap

[D] Stormwater sediment is defined as either catch basin sediment, conveyance line sediment, or stormwater particulates

[E] All values are from DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, January 31, 2007.

| | a blank cell indicates an SLV was not available at the time of the last update. DEQ or EPA may develop additio

[1] The values were chosen by first referring to the PEC's in the paper listed in footnote 2. If the analyte was not found, we then

[2] These values were taken MacDonald DD, Ingersoll C.G., Berger T.A. (2000) Development and Evaluation of Consensus-Ba

[3] Sediment quality value (Hyalella), Washington State, quoted in MacDonald et al. (1999); Appendix 3-1.

[4] Quoted in MacDonald et al. (1999); Appendix 3-1

[5] Lowest Apparent Effects Threshold (LAET), Table 11, WDOE (1997)

[6] Upper Effects Threshold (UET), Freshwater Sediment (NOAA, 1999)

[7] USEPA sediment quality advisory level, quoted in MacDonald et al. (1999); Appendix 3-1

[8] New York State acute criterion, quoted in MacDonald et al. (1999); Appendix 3-1

[9] Severe effect level, British Columbia, quoted in MacDonald et al. (1999); Appendix 3-1

[10] 5x conversion from measured "LOW" to estimated "HIGH", NOAEL to chronic LOAEL per USEPA (1997b)

[11] PEL, British Columbia, quoted in MacDonald et al. (1999); Appendix 3-1

[12] Based on Notice of Availability of Final Aquatic Life Criteria Document for Tributyltin (69 Fed. Reg. 2, 342). USGS web si

[13] These values for aluminum are expressed in terms of "total recoverable" concentration of metal in the water column. The cr

[14] These values were taken from OAR 340-41 Table 20 because they will remain the enforceable values for these particular an

[15] This is a hardness dependent metal. All values were calculated based on 25 mg/l of $CaCO_3$.

[16] Values were taken from Table 33c (OAR 340-41), which are Water Quality Guidance Values, not criteria, that can be used i

[18] Cyanide value is based on a free cyanide value per DEQ OAR 340-41 Table 33, and EPA values are based on total Cyanide

[19] This metal is listed as the total recoverable metal in the water column

[20] This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day

[22] Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: Chro

[23] Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: Chro

[24] Listed as a secondary pollutant by EPA

[#] Table 20 from OAR 340-40 was superceded by Tables 33A, 33B, and 33C. As noted above, 33A and 33C were adopted the (

Tier II SCV

(a) = value for Arsenic V

(b) = see notation for ORNL's Mercury value

(c) = SCV for BHC (other)

(d) = SCV for p,p' DDD

(e) = SCV for p,p' DDT

(f) = SCV for m-Xylene

(g) = SCV for Xylene mixture

(h) = SCV for 1-Methylnaphthalene

General

AWQC = ambient water quality criteria

MRL = minimum reporting limit

NRWQC = National Recommended Water Quality Criteria

ORNL = Oak Ridge National Laboratory

PRG = preliminary remediation goals

(!) Screening level values (SLVs) presented in this table may be
using this Table, DEQ's website should be checked for updates

(j) = Tier II SCV values were taken from Suter II, G.W. and Tsao, C.L., 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effe

MCL

[26] MCL is based on benzo(a)pyrene

[29] National Secondary Drinking Water Standards

[31] Presumed background, per Table A-1, DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, Ja

ɔproved) as potentialARARs under CERCLA. The final determination of whether MCLs or AWQC are ARARs will be mad

ıal SLVs as determined necessary, on a case-by-case basis.
used the other literature listed in footnotes 3 through 11 to find the value.
ısed Sediment Quality Guidelines for Freshwater Ecosystems. Environmental Contamination and Toxicity 39: 20-31.

ite (http://nwis.waterdata.usgs.gov/or/nwis/qwdata/?site_no=14211720&agency_cd=USGS).
ːiterion applies at pH<6.6 and hardness<12 mg/L (as $CaCO_3$)
alytes.

in the application of Oregon's Narrative Toxics Criteria to waters of the state in order to protect aquatic life.

ıic = exp(1.005(ph)-5.134). The value displayed in the table corresponds to a pH of 7.8
ıic = exp(1.005(ph)-5.29). The value displayed in the table corresponds to a pH of 7.8

Ɔregon Environmental Commission and were effective in February 2005. Implementation of Table 33B (i.e.,

revised or augmented as data become available from the Portland Harbor RI/FS or in the event the standards, criteria, guide
to this table at http://www.deq.state.or.us/nwr/PortlandHarbor/jscs.

ɛcts on Aquatic Biota: 1996 Revision. ORNL publication ES/ER/TM-96/R2

ınuary, 31, 2007.

:e in the EPA Portland

:lines or toxicological data are updated. Prior to

[32] Freshwater fish, per Table A-1, DEQ Guidance for Bioaccumulative Chemcials of Concern in Sediment, January 31, 2007.

[33] Human Health General Population, per Table A-1, DEQ Guidance for Bioaccumulative Chemicals of Concern in Sediment,

[34] This value represents the sum of the 2,4' and 4,4' isomers.

[35] This value represents the sum of DDE + DDD + DDT.

TT = see footnote 7 on EPA NPD Drinking Water Standards

Dana's References (need complete reference)

Volume 1

(1) Aroclors - Table 4.4

(2) PCB congners - Table 4.2

(3) Chlorinated Benzenes- Table 3.2

Volume 5

(4) Herbicides - Table 2.2.2

(5) Insecticides- Table 3.2.2

Note:cis-Nonachlor and trans-nonachlor are bioaccumulating components of the pesticide chlordane, which can b

Volume 3

(6) Halogenated hydrocarbons -Table 3.2

(7) Halogenated Ethers - Table 4.2

Volume 4- Oxygen, Nitrogen and sulfur compounds

(8) Table 5.2 Carboxylic Acids

(9) Table 2.2 Alcohols

(10) Table 4.2 Phenolic compounds

Volume 2 - PAHs, Chlorinated Dioxins and Furans

(11)Tabe 4.2 - Chlorinated Furans

[21] Kow for Chlordane mixture

[22] Kow for Endosulfan, not necessarily Endosulfan I or II

[23] Kow for (p,p') DDD, DDE, and DDT

[24] Kow for 1,2 Dichloroethane

[25] Kow for 1,3 Dichloropropene

[26] Kow for Trichloroethylene

[27] Kow for Hexachloro-1,3,-butadiene

[28] Kow for p-Chloroaniline

January 31, 2007.

e detected in various environmental biota and in humans

Total Arsenic.

Chromium VI.

Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC=(exp(1.005(pH)-4.869);
CCC=exp(1.005(pH)-5.134). Value based on pH=7.8.

Sum of 2-4' and 4-4' isomers of either DDE or DDT, 0.000031 ug/L is the value for the sum of 2-4' and 4-4' DDD isomer.

Expressed as total inorganic arsenic. The “water + organism” criterion is based on a risk level of 1 x 10^{-4}

Expressed as total cyanide (CN)/L.

Value for 4-4' DDE

Value for dissolved fraction.

Toxicity varies with hardness. All values were calculated based on 25 mg/l of CaCO3

Expressed as free cyanide.

Evaluated point-by-point on any beach.

Rolling average of 1/2-RM segments by side of river.

Rolling average of 1-RM segments by side of river in using whole body fish data.

Rolling average of 1-RM segments for East nearshore, Navigation Channel, West nearshore sediments

Evaluated point-by-point for pore water or surface water.

Evaluated point-by-point for pore water or ground water.

Evaluated point-by-point for sediment, unless otherwise noted.

Rolling average of 1-RM segments for East nearshore, Navigation Channel, West nearshore sediments

Total DDx and lead in this column evaluated by rolling average of 1-RM segments. Total PCBs evaluated by rolling average of 2-RM segments
2,3,4,7,8-PeCDF evaluated by rolling average of 1-RM segments by side of river.

Evaluated point-by-point in pore water.

Evaluated point-by point in sediment.

Table 2.1-2
Summary of COC Selection Process
Portland Harbor Superfund Site
Portland, Oregon

Contaminant of Potential Concern	BERA COPC	BHHRA COPC	Identified as a COC	Rationale for Eliminating as a COC
1,1-Dichloroethene (1,1-DCE)	X		Y	
1,2,4-Trimethylbenzene	X		N	Ecological weak line of evidence
1,2-Dichlorobenzene	X		Y	
1,3,5-Trimethylbenzene	X		N	Ecological weak line of evidence
1,4-Dichlorobenzene	X		N	
2,4'-DDD	X		N	Evaluate as DDx
2,4-DDT	X		N	Evaluate as DDx
2,4- and 4,4-DDD	X	X	N	Evaluate as DDx
2,4- and 4,4-DDE	X	X	Y	
2,4- and 4,4-DDT	X	X	N	Evaluate as DDx
2-Methylnaphthalene			N	Evaluate as PAH
4,4'-DDD	X		N	Evaluate as DDx
4,4'-DDE	X		N	Evaluate as sum DDE and DDx
4,4'-DDT	X		N	Evaluate as DDx
4-Methylphenol (p-Cresol)	X		N	Ecological weak line of evidence
Acenaphthene	X		N	Evaluate as PAH
Acenaphthylene	X		N	Evaluate as PAH
Aldrin	X	X	Y	
Aluminum	X		N	Ecological weak line of evidence
Ammonia	X		N	Ecological weak line of evidence
Aniline	X		N	Ecological weak line of evidence
Anthracene	X		N	Evaluate as PAH
Antimony	X	X	N	Infrequent and/or anomalous detections
Aroclor 1254	X		N	Evaluate as Total PCBs
Arsenic	X	X	Y	
Bariuim	X		N	Ecological weak line of evidence
Benzene	X		Y	
Benzo(a)anthracene	X	X	N	Evaluate as PAH
Benzo(a)pyrene	X	X	N	Evaluate as PAH
Benzo(b)fluoranthene	X	X	N	Evaluate as PAH
Benzo(g,h,i)perylene	X		N	Evaluate as PAH
Benzo(k)fluoranthene	X	X	N	Evaluate as PAH
Benzyl alcohol	X		N	Ecological weak line of evidence
Beryllium	X		N	Ecological weak line of evidence
beta-Hexachlorocyclohexane (BHC)	X		N	Evaluate as Lindane
Bis(2-ethylhexyl) phthalate (BEHP)	X	X	Y	
Cadmium	X		Y	
Carbazole	X		N	Evaluate as PAH; weak line of evidence
Carbon disulfide	X		N	Ecological weak line of evidence
Chlordane (cis and trans)	X		N	Evaluate as total Chlordanes
Chlorobenzene	X		Y	
Chloroethane	X		N	Ecological weak line of evidence

Chloroform	X		Y	
Chromium	X	X	Y	
Chrysene	X		N	Evaluate as PAH
cis-1,2-Dichloroethene (c-1,2-DCE)	X		Y	
cis-Chlordane	X		N	Evaluate as total Chlordanes
Cobalt	X		N	Ecological weak line of evidence
Copper	X		Y	
Cyanide	X		Y	
Diazinon	X		N	Ecological weak line of evidence
Dibenzo(a,h)anthracene	X	X	N	Evaluate as PAH
Dibenzofuran	X		N	Evaluate as PAH
Dibutyl phthalate	X		N	Ecological weak line of evidence
Dieldrin	X	X	Y	
Diesel range organics	X		N	Ecological weak line of evidence
Dioxin/Furan (2,3,7,8-TCDD Eq)	X	X	Y	
Endrin	X		N	Ecological weak line of evidence
Endrin ketone	X		N	Ecological weak line of evidence
Ethylbenzene	X		Y	
Fluoranthene	X		N	Evaluate as PAH
Fluorene	X		N	Evaluate as PAH
gamma-Hexachlorocyclohexane (Lindane)	X		Y	
Heptachlor epoxide	X		N	Ecological weak line of evidence
Hexachlorobenzene		X	Y	
Indeno(1,2,3-c,d)pyrene	X	X	N	Evaluate as PAH
Iron	X		N	Ecological weak line of evidence
Isopropylbenzene	X		N	Ecological weak line of evidence
Lead	X	X	Y	
m- and p-Xylene	X		Y	
Magnesium	X		N	Ecological weak line of evidence
Manganese	X		Y	
Mecoprop (MCPP)		X	Y	
Mercury	X	X	Y	
Monobutyltin	X		N	Ecological weak line of evidence
Naphthalene	X		N	Evaluate as PAH
Nickel	X		N	Ecological weak line of evidence
o-Xylene	X		Y	
Pentachlorophenol	X	X	Y	
Perchlorate	X		Y	
Phenanthrene	X		N	Evaluate as PAH
Phenol	X		N	Ecological weak line of evidence
Polybrominated diphenyl ethers (PBDE)		X	Y	
Potassium	X		N	Ecological weak line of evidence
Pyrene	X		N	Evaluate as PAH
Silver	X		N	Background
Sodium	X		N	Ecological weak line of evidence
Sulfide	X		N	Infrequent detections and co-located under other COCs (Gasco)
Toluene	X		Y	
Total Chlordanes	X	X	Y	

Total cPAH/BaPEq		X	Y	
Total DDx	X	X	Y	
Total Endosulfan	X		N	Infrequent detections and co-located under other COCs (Arkema)
Total HPAH	X		Y	
Total LPAH	X		Y	
Total PAH	X		Y	
Total PCBs	X	X	Y	
Total PCB TEQ	X	X	N	Evaluate as Total PCBs
Total TEQ	X	X	N	Evaluate as Total PCBs and TCDD TEQ
TPH C4 - C6 Aliphatic	X		N	Ecological weak line of evidence
TPH C6 - C8 Aliphatic	X		N	Ecological weak line of evidence
TPH C8 - C10 Aromatic	X		N	Ecological weak line of evidence
TPH C10-C12 Aliphatic	X		Y	
TPH C10-C12 Aromatic	X		Y	
Total Xylenes	X		Y	
Tributyltin (TBT)	X		Y	
Trichloroethene (TCE)	X		Y	
Vanadium	X		Y	
Zinc	X		Y	

Notes:

COC - contaminant of concern

PAH - polycyclic aromatic hydrocarbon

PCB - polychlorinated biphenyl

Table 2.1-3
Basis for Portland Harbor COC Selection by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	RAO 1		RAO 2			RAO 3	RAO 4	RAO 5	RAO 6		RAO 7	RAO 8
	Direct Contact		Fish and Shellfish Consumption			Drinking Water/Direct Contact	Drinking Water/Direct Contact	Direct Contact/Ingestion	Biota (Prey) Ingestion		Direct Contact/Ingestion	Direct Contact/Ingestion
COCs	Beach	Sediment	Tissue	Sediment	Surface Water	Surface Water	Groundwater	Sediment	Sediment	Surface Water	Surface Water	Pore Water
Arsenic	R	R	R	M	M	S	S	R	--	--	--	--
Cadmium	--	--	--	--	--	--	--	R	R	--	M	R
Chromium	--	--	--	--	--	S	S	R	--	--	M	M
Copper	--	--	--	--	--	--	--	R	R	--	M	R
Lead	--	--	--	--	--	--	--	R	R	--	M	R
Manganese	--	--	--	--	--	S	S	--	--	--	--	R
Mercury	--	--	R	M	M	--	--	R	R	--	M	--
Vanadium	--	--	--	--	--	--	--	--	--	--	--	R
Zinc	--	--	--	--	--	--	S	R	--	--	R	R
Cyanide	--	--	--	--	--	S	S	--	--	--	--	R
Perchlorate	--	--	--	--	--	S	S	--	--	--	--	R
Aldrin	--	--	R	M	M	S	--	--	R	--	M	--
Benzene	--	--	--	--	--	S	S	--	--	--	--	R
Chlordanes	--	--	R	M	M	S	S	R	--	--	M	M
Chlorobenzene	--	--	--	--	--	S	S	--	--	--	--	R
Chloroform	--	--	--	--	--	S	S	--	--	--	--	R
Dioxins/Furans (2,3,7,8-TCDD Eq)	--	R	--	--	--	S	S	--	R	M	M	--
1,2,3,4,7,8-HxCDF	--	--	R	M	M	--	--	--	R	--	--	--
1,2,3,7,8-PeCDD	--	--	R	M	M	--	--	--	R	--	--	--
2,3,4,7,8-PeCDF	--	--	R	M	M	--	--	--	R	--	--	--
2,3,7,8-TCDD	--	--	R	M	M	--	--	--	R	--	--	--
2,3,7,8-TCDF	--	--	R	M	M	--	--	--	R	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	S	S	--	--	--	M	R
Total DDE	--	--	--	--	--	--	--	R	R	--	M	M
DDx	--	--	R	M	M	S	S	R	R	R	R	R
1,1-Dichloroethene	--	--	--	--	--	S	S	--	--	--	--	R
cis-1,2-Dichloroethene	--	--	--	--	--	S	S	--	--	--	--	R
2,4-D	--	--	--	--	--	S	S	--	--	--	S	S
Dieldrin	--	--	R	M	M	S	--	R	--	--	M	--
Ethylbenzene	--	--	--	--	--	S	S	--	--	--	R	R
Bis-2-Ethylhexyphthalate	--	--	R	M	M	S	--	R	R	--	R	--
Hexachlorobenzene	--	--	R	M	M	S	S	--	--	--	S	S
gamma-Hexachlorocyclohexane	--	--	--	--	--	S	S	R	--	--	M	M
MCPP	--	--	--	--	--	R	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	S	S	--	--	--	S	S
Total cPAHs (BaP Eq)	R	R	R	M	M	S	S	--	--	--	--	--
Total PAH	--	--	--	--	--	--	--	R	R	--	R	R
Total LPAH	--	--	--	--	--	--	--	R	--	--	R	R
Total HPAH	--	--	--	--	--	--	--	R	R	--	R	R
TPH (C-10 to C-12 aliphatic)	--	--	--	--	--	--	--	R	--	--	--	R
TPH (C-10 to C-12 aromatic)	--	--	--	--	--	--	--	R	--	--	--	R
PBDEs	--	--	R	M	M	S	--	--	--	--	--	--
PCBs	--	R	R	M	M	S	S	R	R	R	R	M
Tetrachloroethene	--	--	--	--	--	S	S	--	--	--	--	S
Toluene	--	--	--	--	--	S	S	--	--	--	--	R
Tributyltin	--	--	--	--	--	--	--	R	R	--	M	--
1,1,1- Trichloroethane	--	--	--	--	--	S	S	--	--	--	--	S
Trichloroethene	--	--	--	--	--	S	S	--	--	--	--	S
2,4,5-TP	--	--	--	--	--	S	S	--	--	--	S	S
Vinyl chloride	--	--	--	--	--	S	S	--	--	--	--	S
o-Xylene	--	--	--	--	--	S	S	--	--	--	--	R
m- and p-Xylene	--	--	--	--	--	S	S	--	--	--	--	R
Total Xylenes	--	--	--	--	--	S	S	--	--	--	--	R
Benthic Toxicity	--	--	--	--	--	--	--	R	--	--	--	--

Notes:
Basis for COC Selection
R - Conclusion from Baseline Risk Assessment
S - Known upland source not evaluated in risk assessment
M - Media associated with exposure point risk

Table 2.2-4
RAO 1 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

		RAO 1 Reduce cancer risk and noncancer hazards to people from incidental ingestion of and dermal contact with contaminated sediments and riverbank soils by reducing the concentrations of COCs in sediment at the site to acceptable concentrations for subsistence, occupational, recreational, and ceremonial uses.									
		Beach Sediment					Sediment				
COCs	Units	Risk-based PRG (10^{-6})	Risk-based PRG (HQ=1)	ARAR	Background	PRG	Risk-based PRG (10^{-6})	Risk-based PRG (HQ=1)	ARAR	Background	PRG
Arsenic	mg/kg	0.4	37	NA	3	3	1	435	NA	3	3
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/kg	--	--	--	--	--	0.01	1.0	NA	--	0.01
PCBs	µg/kg	--	--	--	--	--	370	14,760	NA	6	370
cPAHs (BaP Eq)	µg/kg	12	--	NA	12	12	106	--	NA	12	106

Notes:
- ARAR - Applicable or relevant and appropriate requirement
- NA - Not applicable
- PRG - Preliminary Remediation Goal
- RAO - Remedial Action Objective
- HQ - Hazard Quotient

Table 2.2-5
RAO 2 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

COCs	RAO 2 Reduce cancer risk and noncancer hazards for people eating fish and shellfish, including infants exposed by being breastfed by mothers who have consumed fish and shellfish, by reducing the concentrations of COCs in sediments, riverbank soils, surface water, and biota at the site to the proposed remediation goals												
	Tissue (fillet)					Sediment						Surface Water	
COCs	Units	Risk-based PRGs (10-6)	Risk-based PRGs (HQ=1)	ARAR	PRG	Units	Risk-based PRG (10-6)	Risk-based PRG (HQ=1)	ARAR	Background	PRG	Units	PRG[1] (10^{-6})
Arsenic	mg/kg	0.001	0.08	NA	0.001	mg/kg	NA	NA	NA	3	NA	µg/L	2.1[3]
Mercury	mg/kg	--	26[4]	0.03[4]	0.03[4]	mg/kg	NA	NA	NA	0.034	NA	µg/L	NA
Aldrin	µg/kg	0.06	8	NA	0.06	µg/kg	2	260	NA	NA	2	µg/L	0.000005
Bis-2-Ethylhexyphthalate	µg/kg	72	5,246	NA	72	µg/kg	NA	NA	NA	61	NA	µg/L	NA
Chlordanes	µg/kg	3	131	NA	3	µg/kg	1.5	181	NA	0.6	1.5	µg/L	0.000081
DDx	µg/kg	3	94	NA	3	µg/kg	6.1	307	NA	3	6.1	µg/L	0.000031[2]
Dieldrin	µg/kg	0.06	13	NA	0.06	µg/kg	1.8	40	NA	NA	1.8	µg/L	0.0000054
1,2,3,4,7,8-HxCDF	µg/kg	0.00008	0.00006	NA	0.00006	µg/kg	0.0003	0.00023	NA	NA	0.00023	µg/L	0.00000000051
1,2,3,7,8-PeCDD	µg/kg	0.000008	0.000006	NA	0.000006	µg/kg	0.00001	0.00001	NA	0.00013[5]	0.00001[6]	µg/L	0.00000000051
2,3,4,7,8-PeCDF	µg/kg	0.00003	0.00002	NA	0.00002	µg/kg	0.0004	0.0003	NA	0.00019[5]	0.0003	µg/L	0.00000000051
2,3,7,8-TCDD	µg/kg	0.000008	0.000006	NA	0.000006	µg/kg	0.0000064	0.000005	NA	0.00014[5]	0.000005[6]	µg/L	0.00000000051
2,3,7,8-TCDF	µg/kg	0.00008	0.00006	NA	0.00006	µg/kg	0.0035	0.003	NA	0.00021[5]	0.003	µg/L	0.00000000051
Hexachlorobenzene	µg/kg	0.6	--	NA	0.6	µg/kg	0.2	--	NA	0.3	0.3	µg/L	0.000029
PBDEs	µg/kg	--	26	NA	26	µg/kg	NA	NA	NA	NA	NA	µg/L	NA
PCBs	µg/kg	0.5	0.25	NA	0.25	µg/kg	0.2	0.1	NA	6	6.0	µg/L	0.0000064
cPAHs (BaP Eq)	µg/kg	0.05	--	NA	0.05	µg/kg	3,950	--	NA	12	3,950	µg/L	0.0018

Notes:
NA - Not applicable
ND - Not determined or detected
1 - These values are from Oregon WQS for human health (organism only).
2 - This value is for the 4-4' isomer of either DDE or DDT; 0.000031 ug/L is the value for the 4-4' DDD isomer.
3 - The arsenic criteria are expressed as total inorganic arsenic. The "water + organism" criterion is based on a risk level of 1×10^{-4}
4 - Tissue values are for methyl mercury.
5 - Insufficient number of detections to calculate a background. Value represents 95th percentile of the ND values in the upstream data set with the Blue Heron West Linn data removed consistent with evaluation in the RI Section 7.
6 - The PRG is less than the achievable detection limit; thus, the PRG is evaluated at the established detection limit from the background data set.

BaP Eq - benzo(a)pyrene equivalent

Table 2.2-6
RAO 3 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

		RAO 3 Reduce cancer risk and noncancer hazards to people from direct contact (ingestion, inhalation, and dermal contact) with contaminants in surface water, and via consumption of fish and shellfish by reducing the concentrations of COCs in surface water at the site to the proposed remediation goals. These goals are			
		Surface Water			
COCs	**Units**	**RSL**	**ARAR (MCL)**	**ARAR (AWQC)**	**PRG**
Arsenic	µg/L	0.045	10	2.1	2.1
Chromium	µg/L	NA	100	NA	100
Manganese	µg/L	320	NA	NA	320
Zinc	µg/L	NA	5,000	2,100	2,100
Cyanide	µg/L	160	200	130	130
Perchlorate	µg/L	11	15	NA	15
Aldrin	µg/L	0.004	NA	0.000005	0.000005
Benzene	µg/L	0.39	5	0.44	0.44
Chlordanes	µg/L	0.19	2	0.000081	0.000081
Chlorobenzene	µg/L	72	100	74	74
Chloroform	µg/L	0.19	80	260	80
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/L	0.00000052	0.00003	5.1E-10	5.10E-10
1,2-Dichlorobenzene	µg/L	280	600	110	110
DDx	µg/L	0.2	NA	0.000022	0.000022
1,1-Dichloroethene	µg/L	280	7	230	7
cis-1,2-Dichloroethene	µg/L	28	70	NA	70
2,4-D	µg/L	1,300	70	100	70
Dieldrin	µg/L	0.0015	NA	0.0000053	0.0000053
Ethylbenzene	µg/L	1.3	700	160	160
Bis-2-Ethylhexylphthalate	µg/L	5.6	6	0.2	0.2
Hexachlorobenzene	µg/L	0.42	1	0.000029	0.000029
gamma-Hexachlorocyclohexane	µg/L	0.036	0.2	0.17	0.17
MCPP	µg/L	12	NA	NA	12
Pentachlorophenol	µg/L	0.035	1	0.15	0.15
PCBs	µg/L	0.17	0.5	0.0000064	0.0000064
cPAHs (BaP Eq)	µg/L	0.0029	0.2	0.0013	0.0013
Tetrachloroethene	µg/L	9.7	5	0.24	0.24
Toluene	µg/L	860	1,000	720	720
1,1,1- Trichloroethane	µg/L	7,500	200	NA	200
Trichloroethene	µg/L	0.44	5	1.4	5
2,4,5-TP	µg/L	84	50	10	10
Vinyl chloride	µg/L	0.015	2	0.023	2
o-Xylene	µg/L	190	NA	NA	190
m- and p-Xylene	µg/L	NA	NA	NA	NA
Total Xylenes	µg/L	190	10,000	NA	10,000

Notes:
NA - Not available

Table 2.2-7
RAO 4 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

COCs	Units	RAO 4 Reduce to acceptable levels human health risks resulting from exposure to contaminated groundwater by reducing the concentrations of COCs in pore water at the site to the proposed remediation goals.			
		Groundwater			
		RSL	ARAR (MCL)	ARAR (AWQC)	PRG
Arsenic	µg/L	0.045	10	2.1	2.1
Chromium	µg/L	NA	100	NA	100
Manganese	µg/L	320	NA	NA	320
Zinc	µg/L	NA	5,000	2,100	2,100
Cyanide	µg/L	160	200	130	130
Perchlorate	µg/L	11	15	NA	15
Aldrin	µg/L	0.004	NA	0.000005	0.000005
Benzene	µg/L	0.39	5	0.44	0.44
Chlordanes	µg/L	0.19	2	0.000081	0.000081
Chlorobenzene	µg/L	72	100	74	74
Chloroform	µg/L	0.19	80	260	80
1,2-Dichlorobenzene	µg/L	280	600	110	110
DDx	µg/L	0.2	NA	0.000022	0.000022
1,1-Dichloroethene	µg/L	280	7	230	7
cis-1,2-Dichloroethene	µg/L	28	70	NA	70
2,4-D	µg/L	1,300	70	100	70
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/L	0.00000052	0.00003	5.1E-10	5.10E-10
Dieldrin	µg/L	0.0015	NA	0.0000053	0.0000053
Ethylbenzene	µg/L	1.3	700	160	160
Hexachlorobenzene	µg/L	0.42	1	0.000029	0.000029
gamma-Hexachlorocyclohexane	µg/L	0.036	0.2	0.17	0.17
Pentachlorophenol	µg/L	0.035	1	0.15	0.15
PCBs	µg/L	0.17	0.5	0.0000064	0.0000064
cPAHs (BaP Eq)	µg/L	0.0029	0.2	0.0013	0.0013
Tetrachloroethene	µg/L	9.7	5	0.24	0.24
Toluene	µg/L	860	1,000	720	720
1,1,1- Trichloroethane	µg/L	7,500	200	NA	200
Trichloroethene	µg/L	0.44	5	1.4	5
2,4,5-TP	µg/L	84	50	10	10
Vinyl chloride	µg/L	0.015	2	0.023	2
o-Xylene	µg/L	190	NA	NA	190
m- and p-Xylene	µg/L	NA	NA	NA	NA
Total Xylenes	µg/L	190	10,000	NA	10,000

NA - Not available

Table 2.2-8
RAO 5 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

COCs	Units	RAO 5 Reduce risk to ecological receptors from ingestions of and direct contact with contaminated sediments and riverbank soils by			
		Sediment			
		Risk-based PRG (HQ=1)	ARAR	Background	PRG
Arsenic	mg/kg	33	NA	3	33
Cadmium	mg/kg	5	NA	0.12	5
Chromium	mg/kg	111	NA	24	111
Copper	mg/kg	149	NA	26	149
Lead	mg/kg	128	NA	7.7	128
Mercury	mg/kg	1.1	NA	0.034	1.1
Zinc	mg/kg	459	NA	77	459
Chlordanes	µg/kg	18	NA	0.4	18
DDE	µg/kg	31	NA	NA	31
DDx	µg/kg	63	NA	2	63
Dieldrin	µg/kg	62	NA	NA	62
gamma-Hexachlorocyclohexane	µg/kg	5	NA	NA	5
Bis-2-Ethylhexylphthalate	µg/kg	135	NA	61	135
Total PCBs	µg/kg	64	NA	6	64
Total PAH	µg/kg	23,000	NA	73	23,000
Total LPAH	µg/kg	1,500	NA	NA	1,500
Total HPAH	µg/kg-%fines	150,000	NA	NA	150,000
TPH (C-10 to C-12 aliphatic)	µg/kg	3,900	NA	NA	3,900
TPH (C-10 to C-12 aromatic)	µg/kg	11,000	NA	NA	11,000
Tributyltin	mg/kg	3.1	NA	NA	3.1
Benthic Toxicity	Maximum allowable survival or biomass reduction (see Note 1)				

Notes:

NA - Not applicable

1 - Benthic Toxicity Narrative Requirement:

Chironomus dilutus 10-day survival: survival > 84%
Chironomus dilutus 10-day biomass: biomass > 82% of the laboratory negative control biomass
Hyalella azteca 28-day survival: survival > 79%
Hyalella azteca 28-day biomass: biomass > 66% of the laboratory negative control biomass

In addition to having survival or biomass values lower than the above PRG percentages, each individual sample with survival or biomass lower than its respective PRGs must have survival or biomass statistically significantly lower than that of the laboratory negative control sediment response, as determined using either a one-tailed parametric t-test, or a one-tailed non-parametric Mann-Whitney U test (sometimes referred to as the Wilcoxon rank sum test or WRS test, either name is fine), with a statistical significance level of $p < 0.05$. Survival/biomass and statistical significance tests must both fail before an individual sample is considered to have exceeded a toxicity based PRG.

Table 2.2-9
RAO 6 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

COCs	RAO 6 Reduce risks to ecological receptors that consume contaminated prey by reducing the concentrations of COCs in sediments and biota at the site to the proposed remediation goals.								
	Sediment					Surface Water			
	Units	Risk-based PRG (HQ=1)	ARAR	Background	PRG	Units	TRV From BERA	ARAR	PRG
Cadmium	mg/kg	NA	NA	0.12	NA				
Copper	mg/kg	NA	NA	26	NA				
Mercury	mg/kg	NA	NA	0.034	NA				
Aldrin	µg/kg	139	NA	NA	139				
DDE	µg/kg	2.8	NA	NA	7.1				
DDx	µg/kg	2,850	NA	2	2,850	µg/L	0.011	0.001	0.001[1]
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/kg	0.0034	NA	NA	0.0034	µg/L	0.001	0.000038	0.001
1,2,3,4,7,8-HxCDF	µg/kg	236	NA	NA	236				
1,2,3,7,8-PeCDD	µg/kg	6.9	NA	0.00013[2]	6.9				
2,3,4,7,8-PeCDF	µg/kg	94	NA	0.00019[2]	94				
2,3,7,8-TCDD	µg/kg	4.4	NA	0.00014[2]	4.4				
2,3,7,8-TCDF	µg/kg	28.3	NA	0.00021[2]	28.3				
Bis-2-Ethylhexylphthalate	µg/kg	NA	NA	61	NA				
Total PCBs	µg/kg	31	NA	6	31	µg/L	0.19	0.014	0.014
Total PAHs	µg/kg	NA	NA	73	NA				
Tributyltin	mg/kg	NA	NA	NA	NA				

Notes:
NA - Not available.
1 - This value is for 4,4'-DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).
2 - Insufficient number of detections to calculate a background. Value represents 95th percentile of the ND values in the upstream data set with the Blue Heron West Linn data removed consistent with evaluation in the RI Section 7.

Table 2.2-10
RAO 7 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

	RAO 7 Reduce risks to ecological receptors from ingestion o direct contact with contaminants in surface water by the concentrations of COCs in surface water at the si proposed remediation goals.		
	Surface Water		
COCs	**Units**	**TRV from BERA**	**ARAR**
Arsenic	µg/L	NA	190
Cadmium	µg/L	0.09	0.09
Chromium	µg/L	NA	11
Copper	µg/L	2.74	3.6
Lead	µg/L	0.54	0.54
Mercury	µg/L	NA	0.012
Zinc	µg/L	36.5	36.5
Cyanide	µg/L	5.2	5.2
Aldrin	µg/L	3	3
Chlordanes	µg/L	0.0043	0.0043
1,2-Dichlorobenzene	µg/L	14	NA
DDE	µg/L	NA	NA
DDx	µg/L	0.011	0.001
2,4-D	µg/L	NA	NA
Dieldrin	µg/L	0.056	0.056
Ethylbenzene	µg/L	7.3	NA
Bis-2-Ethylhexpyphthalate	µg/L	3	NA
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/L	0.001	0.000038
Hexachlorobenzene	µg/L	NA	NA
gamma-Hexachlorocyclohexane	µg/L	0.08	0.08
Pentachlorophenol	µg/L	NA	13
Total PCBs	µg/L	0.19	0.014
Total PAHs	µg/L	NA	NA
Total LPAHs	µg/L	12	NA
Total HPAHs	µg/L	0.014	NA
Tributyltin	µg/L	NA	0.063
2,4,5-TP	µg/L	NA	NA

Notes:
NA - Not available
1 - ARAR is more conservative but TRV was selected because of the receptor assumptions in the value.
2 - This value is for total Arsenic (Arsenic III + Arsenic V).
3 - This value is for the dissolved fraction.
4 - This is a hardness dependent metal. All values were calculated based on 25 mg/l of CaCO3
5 - The value for cadmium is calculated as follows: CCC=(exp(0.7409*ln(hardness)-4.719))*(1.101672-(ln(hardness)*0.041838))
6 - This value is for Chromium VI.
7 - The value for lead is calculated as follows: CCC=(exp(1.273*ln(hardness)-4.705))*(1.46203-(ln(hardness)*0.145712))
8 - The value for zinc is calculated as follows: CCC=(exp(0.8473*ln(hardness)+0.884))*0.986
9 - The value for pentachlorophenol is expressed as a function of pH, and is calculated as follows: CCC=exp(1.005(pH)-5.134). Value based on pH=7.8.
10 - This value is expressed as free cyanide (CN)/L.

Table 2.2-11
RAO 8 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

	RAO 8 Reduce risks to ecological receptors fro and direct contact with contaminants in groundwater by reducing the concentra COCs in pore water at the site to the pro		
	Pore Water		
COCs	**Units**	**TRV from BERA**	**A**
Arsenic	µg/L	NA	
Chromium	µg/L	NA	
Lead	µg/L	0.54	
Manganese	µg/L	120	
Mercury	µg/L	NA	
Vanadium	µg/L	20	
Zinc	µg/L	36.5	
Cyanide	µg/L	5.2	
Perchlorate	µg/L	9,300	
Benzene	µg/L	130	
Chlorobenzene	µg/L	64	
Chlordanes	µg/L	NA	
Chloroform	µg/L	28	
Dioxins/Furans (2,3,7,8-TCDD Eq)	µg/L	NA	
1,2-Dichlorobenzene	µg/L	14	
1,1-Dichloroethene	µg/L	25	
cis-1,2-Dichloroethene	µg/L	590	
DDE	µg/L	NA	
DDx	µg/L	0.011	
2,4-D	µg/L	NA	
Ethylbenzene	µg/L	7.3	
Hexachlorobenzene	µg/L	NA	
gamma-Hexachlorocyclohexane	µg/L	NA	
Pentachlorophenol	µg/L	NA	
PCBs	µg/L	NA	
Total PAHs	µg/L	Note 1	
Total LPAHs	µg/L	12	
Total HPAHs	µg/L	0.014	
Tetrachloroethene	µg/L	NA	
Toluene	µg/L	9.8	
TPH (C-10 to C-12 aliphatic)	µg/L	2.6	
TPH (C-10 to C-12 aromatic)	µg/L	2.6	
1,1,1- Trichloroethane	µg/L	NA	
Trichloroethene	µg/L	47	
2,4,5-TP	µg/L	NA	
Vinyl chloride	µg/L	NA	
o-Xylene	µg/L	13	
m- and p-Xylene	µg/L	67	
Total Xylenes	µg/L	13	

Notes:
NA - Not available
1 - Anthracene = 0.73 ug/L; Benzo(a)anthracene = 0.027 ug/L; Benzo(a)pyrene = 0.014 ug/L; 2-methylnaphthalene = 2.1 ug/L; Naphthalene = 12 ug/L.

Table 2.2-12
Basis for Portland Harbor PRGs by RAO and Media
Portland Harbor Superfund Site
Portland, Oregon

	RAO 1		RAO 2			RAO 3	RAO 4
COCs	**Beach**	**Sediment**	**Tissue**	**Sediment**	**Surface Water**	**Surface Water**	**Groundwater**
Arsenic	B	B	R - ca	NA	R3	A1	A1
Cadmium	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	A2	A2
Copper	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	R2	R2
Mercury	--	--	R - nc	NA	NA	--	--
Vanadium	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	A1	A1
Cyanide	--	--	--	--	--	A1	A1
Perchlorate	--	--	--	--	--	A2	A2
Aldrin	--	--	R - ca	R - ca	R3	A1	A1
Benzene	--	--	--	--	--	A1	A1
Chlordanes	--	--	R - ca	R - ca	R3	A1	A1
Chlorobenzene	--	--	--	--	--	A1	A1
Chloroform	--	--	--	--	--	A2	A2
Dioxins/Furans (2,3,7,8-TCDD Eq)	--	R - ca	--	--	--	A1	A1
1,2,3,4,7,8-HxCDF	--	--	R - nc	R - nc	R3	--	--
1,2,3,7,8-PeCDD	--	--	R - nc	R - nc	R3	--	--
2,3,4,7,8-PeCDF	--	--	R - nc	R - nc	R3	--	--
2,3,7,8-TCDD	--	--	R - nc	R - nc	R3	--	--
2,3,7,8-TCDF	--	--	R - nc	R - nc	R3	--	--
1,2-Dichlorobenzene	--	--	--	--	--	A1	A1
DDE	--	--	--	--	--	--	--
DDx	--	--	R - ca	R - ca	R3	A1	A1
1,1-Dichloroethene	--	--	--	--	--	A2	A2
cis-1,2-Dichloroethene	--	--	--	--	--	A2	A2
trans-1,2-Dichloroethene	--	--	--	--	--	--	--
2,4-D	--	--	--	--	--	A2	A2
Dieldrin	--	--	R - ca	R - ca	R3	A1	A1
Ethylbenzene	--	--	--	--	--	A1	A1
Bis-2-Ethylhexylphthalate	--	--	R - ca	NA	R3	A1	--
Hexachlorobenzene	--	--	R - ca	B	R3	A1	A1
gamma-Hexachlorocyclohexane	--	--	--	--	--	A1	A1
MCPP	--	--	--	--	--	R2	--
PBDEs	--	--	R - nc	NA	NA	--	--
Pentachlorophenol	--	--	--	--	--	A1	A1
PCBs	--	R - ca	R - nc	B	R3	A1	A1
cPAHs (BaP Eq)	R - ca	R - ca	R - ca	R - ca	R3	A1	A1
Total PAHs	--	--	--	--	--	--	--

RAO 5	RAO 6		RAO 7	RAO 8
Sediment	Sediment	Surface Water	Surface Water	Pore Water
R-nc	--	--	A3	--
R-nc	--	--	A3	--
R-nc	--	--	A3	--
R-nc	--	--	R-nc	--
R-nc	--	--	A3	R-nc
--	--	--	--	R-nc
R-nc	--	--	A3	--
--	--	--	--	R-nc
R-nc	--	--	A3	R-nc
--	--	--	A3	R-nc
--	--	--	--	R-nc
--	R-nc	--	A3	--
--	--	--	--	R-nc
R-nc	--	--	A3	--
--	--	--	--	R-nc
--	--	--	--	R-nc
--	R-nc	R-nc	A3	--
--	R-nc	--	--	--
--	R-nc	--	--	--
--	R-nc	--	--	--
--	R-nc	--	--	--
--	R-nc	--	--	--
--	--	--	R-nc	R-nc
R-nc	R-nc	--	--	--
R-nc	R-nc	A3	R-nc	R-nc
--	--	--	--	R-nc
--	--	--	--	R-nc
--	--	--	--	--
--	--	--	--	--
R-nc	--	--	A3	--
--	--	--	R-nc	R-nc
R-nc	--	--	R-nc	--
--	--	--	--	--
R-nc	--	--	A3	--
--	--	--	--	--
--	--	--	--	--
--	--	--	A3	--
R-nc	R-nc	A3	R-nc	--
--	--	--	--	--
R-nc	--	--	--	R-nc

Total LPAHs	--	--	--	--	--	--	--
Total HPAHs	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	A1	A1
Toluene	--	--	--	--	--	A1	A1
TPH (C-10 to C-12 aliphatic)	--	--	--	--	--	--	--
TPH (C-10 to C-12 aromatic)	--	--	--	--	--	--	--
Tributyltin	--	--	--	--	--	--	--
1,1,1- Trichloroethane	--	--	--	--	--	A2	A2
Trichloroethene	--	--	--	--	--	A2	A2
2,4,5-TP	--	--	--	--	--	A1	A1
Vinyl chloride	--	--	--	--	--	A2	A2
o-Xylene	--	--	--	--	--	R2	R2
m- and p-Xylene	--	--	--	--	--	--	--
Total Xylenes	--	--	--	--	--	R2	R2
Benthic Toxicity	--	--	--	--	--	--	--

R-ca Cancer risk-based threshold
R-nc Non-cancer risk-based threshhold or TRV from BERA
R2 Regional Screening Level for Tap Water (Nov 2013)
R3 Based on Oregon WQS Table 40 (organism only)
A1 ARAR - Oregon WQS Table 40 (organism + water)
A2 ARAR- MCL (Nov 2013)
A3 ARAR - Based on Oregon WQS Table 30 (chronic or acute when chronic not available) - April 10, 2014
A4 ARAR - National Water Qualtiy Criteria for Aquatic Life
B Background

R-nc	--	--	R-nc	R-nc
R-nc	--	--	R-nc	R-nc
--	--	--	--	--
--	--	--	--	R-nc
R-nc	--	--	--	R-nc
R-nc	--	--	--	R-nc
R-nc	--	--	A3	--
--	--	--	--	--
--	--	--	--	R-nc
--	--	--	--	--
--	--	--	--	--
--	--	--	--	R-nc
--	--	--	--	R-nc
--	--	--	--	R-nc
R-nc	--	--	--	--

Table 2.4-1
Initial Screening of Remedial Technologies and Process Options
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action	None	Not Applicable	Under No Action, no active remediation of any kind is implemented. The No Action response serves as a baseline against which the performance of other remedial alternatives may be compared. The NCP requires that No Action be considered as a potential remedial action in a feasibility study. Under the No Action alternative in the Study Area, contaminated river sediments would be left in place, without treatment or containment.	Required for consideration by NCP.
Institutional Controls	Governmental Controls	Commercial Fishing Bans	Commercial fishing bans are government controls that ban commercial fishing for specific species or sizes of fish or shellfish and are established by state departments of health or other governmental entities.	Retained site-wide.
		Waterway Use Restrictions or Regulated Navigation Areas	Provides notice to navigation to prevent damage to caps, in-situ treatment, EMNR, etc.	Retained site-wide.
	Proprietary Controls	Land Use/Access Restrictions	Restrictions, such as deed restrictions, easements, and covenants, placed in property related documents or physical barriers, such as fences.	Retained site-wide.
		Structure Mainenance Agreements	Requirements to conduct maintenance of in-water structures where caps or burried contamination are co-located in river.	Retained site-wide.
	Enforcement and Permit Tools	Permit Processes or Provisions of Administrative Orders or Consent Decrees	Legal tools, such as administrative orders, permits, and Consent Decrees (CDs), that limit certain site activities or require the performance of specific activities (e.g., to monitor and report on an IC's effectiveness). They may be issued unilaterally or negotiated.	Retained site-wide.
	Informational devices	Isolation Barriers	Construction fencing, geofabric, or other devise to prevent human interference with isolated contamination.	Retained site-wide.
		Fish Consumption Advisories	Fish consumption advisories provide information to the public from state departments of health or other governmental entities on acceptable fish consumption rates and fish preparation techniques.	Retained site-wide.
Monitored Natural Recovery	Physical Transport	Desorption, dispersion, diffusion, dilution, volatilation, resuspension, and transport.	Natural ongoing processes that reduce toxicity through transformation or reduce bioavailability through increased sorption, destruction, or reduction of bioavailability or toxicity of contaminants in sediment.	Retained site-wide.
	Chemical and Biological Degradation	Dechlorination (aerobic and anaerobic), bioderadation	Natural ongoing processes that dechlorinate or degrade chemical toxicity through biological processes.	Retained site-wide.
	Physical Burrial Process	Sedimentation	Reduce exposure through natural burial or mixing-in-place.	Retained site-wide.
Enhanced Monitored Recovery	Enhanced Burrial/Dilution	Thin Layer Cap	Enhancement of MNR (e.g., burial) through placement of a thin layer of material (e.g., 6" of sand).	Retained site-wide.
Containment in Place	Capping	Engineered Cap	Physical isolation of contaminants with sand cover.	Retained site-wide. Retained site-wide.
		Armored Cap	Physical isolation of contaminants with sand cover and other structural elements (such as armor) as necessary to keep the cap stable.	Retained site-wide.
		Clay Cap	Physical isolation of contaminantswith clay aggregate materials (e.g. , AquaBlok™) consisting of a gravel/rock core covered by a layer of clay mixed with polymers that expand in water decreasing the material's permeability.	Retained site-wide.
		Composite Cap (e.g., HDPE, Geotextile)	Physical and/or chemical isolation of contaminants by layering heavy-duty composite protection mat designed for placement over sediments to guard against damage by erosion, scouring, heavy equipment or other forces.	Retained site-wide.
		Reactive Cap	Placement of active capping layers such as activated carbon or organoclay to reduce contaminant flux through capping materials. Same technology as described above for other cap process options, depending on environmental conditions.	Retained site-wide. Limited to areas where contaminanted groundwater plumes or leachable contaminants are present.
		Slurry Bioremediation	Addition of nutrients and other amendments to enhance bioremediation	
		Phytoremediation	Use of plants to remediate contaminated sediments	

In-Situ Treatment	Biological Treatment	Aerobic Biodegradation	Bioremediation uses microorganisms to degrade organic contaminants in soil, sludge, and solids in situ. The microorganisms break down contaminants by using them as a food source or cometabolizing them with a food source. Aerobic processes require an oxygen source, and the end products typically are carbon dioxide and water.	Screened out site-wide since it is not considered feasible to implement in-situ biological treatment on contaminants are either not biodegradable (particularly heavy metals) or are very persistent in the environment (e.g. , PCDD/F, PCB, pesticides).
		Anaerobic Biodegradation	Bioremediation uses microorganisms to degrade organic contaminants in soil, sludge, and solids either excavated or in situ. The microorganisms break down contaminants by using them as a food source or cometabolizing them with a food source. Anaerobic processes are conducted in the absence of oxygen, and the end products can include methane, hydrogen gas, sulfide, elemental sulfur, and dinitrogen gas.	
		Imbiber Beads	Spherical plastic particles that absorb a very broad cross section of the organic chemical spectrum.	
	Chemical	Chemical Slurry Oxidation	Application of chemical oxidants to remediate contaminated sediments. Chemical oxidation typically involves reduction/oxidation (redox) reactions that chemically convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, or inert.	Screened out site-wide. There are no known sediment applications of in-situ chemical treatment involving the injection and subsequent removal of chemical reagents to demonstrate effectiveness and implementability of forming less toxic by-products on a large scale.
	Physical - Immobilization	Solidification/Stabilization	In-situ immobilization methods typically involve amending sediments in place with reagents, such as cement, quicklime, grout, or pozzolanic materials, that immobilize and/or bind contaminants to the sediment in a solid matrix or chemically stable form. These agents are mixed through the zone of contamination using conventional excavation equipment or a specially designed injection apparatus.	Retained site-wide. Limited to areas where access and slope stability issues exist (e.g., contaminated banks behind major structures with limited access).
		Sequestration	Sequestration is an innovative in-situ technology that involves the use of remedial agents like activated carbon, organoclays, apatite, and zeolites to reduce the toxicity, bioavailability and mobility of sediment contaminants. These agents are mixed into the sediment surface layer typically by mechanical means. SediMiteTM is a low impact system for delivery of remedial agents to the sediment surface. It is an agglomerate comprised of a treatment agent like activated carbon, a weighting agent, and an inert binder. The weighting agent enables the SediMiteTM granular material to sink to the surface and release the activated carbon which is then mixed by bioturbation.	Retained site-wide in areas subject to EMNR.
		Ground Freezing	The ground freezing process converts in situ pore water to ice through the circulation of a chilled liquid via a system of small-diameter pipes placed in drilled holes. The ice acts to fuse the soil or rock particles together, creating a frozen mass of improved compressive strength and impermeability. Brine is the typical cooling agent, although liquid nitrogen can be used in emergency situations or where the freeze is only required to be maintained for a few days.	Screened out site-wide.
Removal	Excavation	Dry Excavation	Use of excavators, buckets, etc. deployed from land based equipment. Can be "in the wet" or "in the dry" in combination with sheet piles, coffer dams, or other measures to remove water.	Retained site-wide for consideration in nearshore areas.
	Dredging	Mechanical Dredging	Use of clamshell, closed, hydraulic, or other buckets to remove contaminated sediment from a barge or other vessels.	Retained site-wide.
		Hydraulic Dredging	Use of hydraulic dredges (e.g., cutterhead, horizontal auger, plain suction, pneumatic, or specialty dredges) with various cutter and suction heads to remove contaminated sediments from the environment in a slurry phase.	Retained site-wide.
		Small Scale Dredge Equipment	Diver assisted or hand held hydraulic dredging, Mud Cat, and similar small scale removal methods.	Retained site-wide for consideration around structures.
	Commercial Landfill	Hillsboro	A disposal site where solid waste is buried between layers of dirt and other materials in such a way as to reduce contamination of the surrounding land. Modern landfills are often lined with layers of absorbent material and sheets of plastic to keep pollutants from leaking into the soil and water.	Retained site-wide.
		Northern Wasco County		Retained site-wide.
		Roosevelt Regional		Retained site-wide.
		Columbia Ridge (Subtitle D)		Retained site-wide.
		Chem Waste (Subtitle C)		Retained for consideration for RCRA contaiminated waste.
	Onsite Upland Landfill	No likely candidate property.	A disposal site where solid waste is buried between layers of dirt and other materials in such a way as to reduce contamination of the surrounding land. Modern landfills are often lined with layers of absorbent material and sheets of plastic to keep pollutants from leaking into the soil and water.	Screened out site-wide due to lack of location and floodplain issues.
		Willamette River (RM 4/5)		Screened out due to interference with Federal Navigation use.

Confinement/Disposal	Confined Aquatic Disposal (CAD)	Willamette River (RM 9)	Dredged material deposited in depressions or excavated pits or placed behind subaqueous lateral berms (at a nearshore location) followed by subaqueous covering or capping. If an engineered cap is used in conjunction with CAD at the disposal site, the potential need for armor in erosive areas must be evaluated, and cap maintenance would be required to ensure longterm chemical isolation of the disposed material. The final grade of a capped CAD cell would be similar to the adjacent subaqueous surface elevation.	Screened out due to interference with Federal Navigation use
		Swan Island Lagoon (RM 8)		Screened out due to current and reasonably likely future uses and requires permanent institutional controls (e.g., deed restrictions, dredging moratorium) that may affect future development and uses of Swan Island Lagoon
		Columbia River (RM 102.5)		Retained site-wide.
		Ross Island (RM 15)		Retained site-wide.
	Confined Disposal Facility (CDF)	Terminal 4 Slip 1	A CDF may be constructed as an in-water site (i.e., a containment island). An in-water CDF can be constructed with dikes or other containment structures to contain the contaminated dredged material, isolating it from the surrounding environment. The in-water CDF ultimately converts open water to dry land. A CDF may also be constructed as a nearshore site (i.e., in water with one or more sides adjacent to land). The Nearshore CDF converts open water to dry land. In some cases, a Nearshore CDF can be integrated with site reuse plans to both reduce environmental risk and simultaneously foster redevelopment in urban areas and brownfields sites (USEPA, 2005).	Retained site-wide. Excludes RCRA contaminated waste.
		Swan Island Lagoon		Retained site-wide. Excludes RCRA contaminated waste.
		Arkema		Retained for Arkema. Excludes RCRA contaminated waste.
	Physical	Particle Separation	Contaminated fractions of solids are concentrated through gravity, magnetic, or sieving separation processes.	Retained site-wide.
		Cement Solidification/Stabilization	The mobility of contaminants in sediments is reduced through addition of Portland cement.	Retained site-wide.
		Sorbent Clay Solidification/Stabilization	The mobility of contaminants in sediments is reduced through addition of sorbent clays such as bentonite.	Retained site-wide.
	Biological Methods	Land Farming/Composting	Sediment is mixed with amendments and placed on a treatment area that typically includes leachate collection. The soil and amendments are mixed using conventional tilling equipment or other means to provide aeration. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation. Other organic amendments such as wood chips, potato waste, or alfalfa are added to composting systems.	Retained for areas with only petroleum hydrocarbons.
		Biopiles	Large scale land treatment of petroleum hydrocarbons to reduce contaminant concentrations through biodegradation in biocells, bioheaps, biomounds, and compost piles. This is an aerated static pile composting process in which compost is formed into piles and aerated with blowers or vacuum pumps. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation.	Retained for areas with only petroleum hydrocarbons.
		Fungal Biodegradation	Large scale land treatment to reduce organic contaminant concentrations by using fungal lignin-degrading or wood-rotting enzyme systems (example: white rot fungus).	Retained site-wide.
		Slurry-phase Treatment	An aqueous slurry is created by combining sediment with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the contaminants. Upon completion of the process, the slurry is dewatered and the treated sediment is removed for disposal (example: sequential anaerobic/aerobic slurry-phase bioreactors).	Retained site-wide.
		Enhanced Biodegradation	Acceleration of the natural bioremediation processes by adding oxygen, reducing agents, nutrients, and degrading microrganisms to the sediment to improve the rate of natural biodegradation. Use of heat to break carbon-halogen bonds and to volatilize light organic compounds (example: D-Plus [Sinre/DRAT]).	Retained site-wide.
	Chemical	Acid Extraction	Use of acids to extract contaminants from dredged sediments. Suitable for sediments contaminated with metals, but not applicable to PCBs or SVOCs. No data on TBT.	Eliminated.
		Solvent Extraction	Use of solvents to extract contaminants from dredged sediments.	Retained sitie-wide for consideration for sediments contaning total PCBs greater than 50 ppm.
		Sediment Washing	A physio-chemical process that uses impact forces in conjunction with chemicals to desorb contaminants from solid sediment particles of all sizes. During this process, contaminants are extracted and concentrated into the sludge associated with water treatment. Depending on the reagents used, in some instances, contaminants may be oxidized.	Retained site-wide for high volumes of removed sediments containing organic contaminants and coarse grain material.

Ex-Situ Treatment	Physical/Chemical	Chemical Oxidation/Reduction	Reducing/oxidizing agents are used to chemically convert toxic contaminants in excavated waste materials to less toxic compounds that are more stable, less mobile, and/or inert. Commonly used reducing/oxidizing agents are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. Target contaminant group for chemical redox is inorganics. Less effective for nonhalogenated VOCs, SVOCs, fuel hydrocarbons, and pesticides. Not cost-effective for high contaminant concentrations because of large amounts of oxidizing agent required.	Eliminated.
		Dehalogenation	Removal of halogens (e.g., chlorine) through chemical dehalogenation reactions. In the dehalogenation process, sediment are screened, processed with a crusher and pug mill, and mixed with sodium bicarbonate (base catalyzed decomposition) or potassium polyethylene glycol. The mixture is heated to above 630 °F in a rotary reactor to decompose and volatilize contaminants. Process produces biphenyls, olefins, and sodium chloride. PCB and dioxin-specific technology. Generates secondary waste streams of air, water, and sludge. Similar to thermal desorption, but more expensive. Solids content above 80% is preferred. Technology is not applicable to metals.	Eliminated.
		Radiolytic Dechlorination	Radiolytic (electron beam) and photolytic (ultraviolet, UV) dechlorination of polychlorinated biphenyls (PCBs). Sediment is placed in alkaline isopropanol solution and gamma irradiated. Products of this dechlorination process are biphenyl, acetone, and inorganic chloride. Process must be carried out under inert atmosphere. Only bench-scale testing has been performed. Difficult and expensive to create inert atmosphere for full-scale project.	Eliminated.
	Thermal Methods	Incineration	Temperatures greater than 1,400°F are used to volatilize and combust organic contaminants. Commercial incinerator designs are rotary kilns equipped with an afterburner, a quench, and an air pollution control system.	Retained for RCRA-listed waste prior to land disposal of treated residuals.
		Pyrolysis	Chemical decomposition induced in organic materials by heat in the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 430°C (800°F). High moisture content increases treatment cost. Generates air and coke waste streams. Target contaminant groups are SVOCs and pesticides. It is not effective in either destroying or physically separating inorganics from the contaminated medium.	Eliminated.
		High Temperature Thermal Desorption	Heating of contaminated sediment to drive off and capture contaminants. Involves the application of heat (320 to 560°C or 600 to 1,000°F) to excavated wastes to volatilize organic contaminants and water. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system, such as a thermal oxidation or recovery unit.	Retained for consideration for sediments contaning total PCBs greater than 50 ppm.
		Low Temperature Thermal Desorption	Involves the application of heat (90 to 320°C or 200 to 600°F) to excavated wastes to volatilize organic contaminants and water. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a treatment system, such as a thermal oxidation or recovery unit.	Retained site-wide.
		High Pressure Oxidation	This process includes two related technologies: wet air oxidation and supercritical water oxidation. Both technologies use the combination of high temperature and pressure to break down organic compounds. Predominantly for aqueous-phase contaminants. Wet air oxidation is a commercially-proven technology for municipal wastewater sludges and destruction of PCBs is poor. Supercritical water oxidation has demonstrated success for PCB destruction.	Eliminated.
		Vitrification	Vitrification is a process in which higher temperatures (2,500°F to 3,000°F) are used to destroy organic chemicals by melting the contaminated dredged material to form a glass aggregate product. The glass aggregates can be used for beneficial use products such as hot mix asphalt, construction fill, cement substitutes and ceramic floor tiles. Vitrification has been demonstrated to be very effective in destroying organic contaminants such as PCDD/F, PCBs, and PAHs in dredged material.	Retained site-wide.

Table 2.4-2
Technology and Process Options Screening Summary
Portland Harbor Superfund Site
Portland, Oregon

General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Retained?	Representative Process Option?
No Action	None	Not Applicable	The No Action response is not effective in reducing the baseline unacceptable human health and ecological risks in the Study Area (see Chapters 8 and 9 in RI Report). Does not meet RAOs.	.Technically implementable site-wide	None	Yes	Yes
Institutional Controls	Governmental Controls	Commercial Fishing Bans	Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries; not very effective for recreational fisheries. Ineffective for limiting ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low	Yes. As a component of alternatives that also include active measures.	No
		Waterway Use Restrictions or Regulated Navigation Areas	Enforcement of restrictions in a large waterway is difficult, especially for recreational boaters. Typically used in conjunction with active remedial technologies such as capping, dredging and capping, EMNR and in-situ treatment to enhance long-term effectiveness.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public. Dredging and navigation restrictions would be limited due to extensive navigational use of waterway.	Low		Yes
	Proprietary Controls	Land Use/Access Restrictions	Better for controlling human exposures than ecological exposures. Not effective for ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public.	Low		Yes
		Structure Maintenance Agreements	Enhances effectiveness of capping based remedies by requiring maintenance of co-located structures.	Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public.	Low		No
	Informational Devices	Isolation Barriers	Enforcement of restrictions in a large waterway is difficult. Typically used in conjunction with active remedial technologies such as capping, EMNR and in-situ treatment to enhance long-term effectiveness in river bank areas.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		No
		Fish Consumption Advisories	Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries, not very effective for recreational fisheries. Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low		Yes
Monitored Natural Recovery	Physical Transport	Desorption, dispersion, diffusion, dilution, volatilization, resuspension, and transport.	Physical transport generally increases exposure to contaminants and may result in unacceptable risks to downstream areas or other receiving water bodies.	MNR works best where the source of pollution has been removed. Need to identify if these processes are occurring to a degree likely to result in reduced risk to receptors.	Low	Yes. As a component of alternatives that also include active measures.	No
	Chemical and Biological Degradation	Dechlorination (aerobic and anaerobic), biodegradation	Limited to SVOCs and PAHs. Does not result in complete degradation of PCBs and dioxins/fuans in and acceptable time frame. PCB and dioxin/furan dechlorination is not directly related to toxicity reduction. Not applicable to metals.	MNR works best where the source of pollution has been removed. Need to determin if degradation processes are occurring to a degree likely to result in reduced risk to receptors.	Low		No
	Physical Burial Process	Sedimentation	Works best in depositional areas. Not effective in areas with wave, current or propwash generated erosion or subject to routine dredge maintenance. Requires demonstration of long-term deposition and burial.	MNR works best where the source of pollution has been removed. Need to identify if tdepostional processes are occurring sufficiently to reduce risk to receptors.	Low		Yes
Enhanced Monitored Natural Recovery	Enhanced Burial/Dilution	Thin Layer Cap	Applicable at areas where MNR processes are demonstrated, but faster recovery is required, or as a residual management tool after completion of removal action.	EMNR works best where the source of pollution has been removed.	Low-Moderate	Yes	Yes
		Engineered Cap	Effective for low-solubility and highly sorbed contaminants (e.g., PCBs) where principal transport mechanism is resuspension/deposition. Not effective in potential scour areas from river currents or propeller wash. Not effective in controlling groundwater plumes. Long-term monitoring and maintenance would be required to ensure that a cap remained effective despite these factors. The organic carbon content of the primary capping material may provide some sorptive capacity in an engineered cap allowing the cap to both physically and chemically sequester contaminants and increase its effectiveness.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. Easily applied in situ; however, scouring must be considered. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low	Yes	Yes
		Armored Cap	Armored caps are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect the toxicity or the volume of contaminants.Applicable at areas where increased velocities from river flow or potential scouring due to propeller wash might be expected. Not effective in controlling groundwater plumes.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low-Moderate	Yes, for areas with high erosive forces.	Yes. For areas in main navigation channel.

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Containment in Place	Capping	Clay Cap	Such materials can be used for maintaining slope stability. They are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants. Effective for scour and biointrusion protection and maintaining slope stability. Since the use of subaqueous clay caps over large areas has not been well documented, the effectiveness is unknown.	A primary concern with the use of clay caps is their long-term performance (with respect to maintaining integrity) in areas of significant groundwater upwelling or diversion. However, clay aggregate material and GCLs may be technically implementable and administratively feasible as an armor layer to protect an underlying engineered cap from erosive forces while also reducing friction in erosive areas (compared to friction anticipated to be generated using stone armor).	Moderate	Yes as potential armoring and slope stabilization material.	No
		Composite Cap (e.g., HDPE, Geotextile)	Porous geotextile cap layers do not achieve sediment isolation, but are effective in reducing the potential for mixing and displacement of the underlying sediment with the cap material. Geotextiles allow the sediments to consolidate and gain strength under the load of additional cap material. Effective in reducing cap thickness, providing additional floor-support, providing bioturbation barrier, or areas where methane generation may be issue. They are effective in reducing the mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation. Implementability over large areas may be challenging.	Low-Moderate	Yes, for areas that do not otherwise have the strength to support a cap.	No
		Reactive Cap	Reactive caps are effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect toxicity or volume of contaminants. They are specific to chemical being managed; demonstrated effectiveness for PAHs, PCBs, dioxins and furans and chlorinated pesticides. Bench scale efffectivenss for metals. May not be effective where multiple types of contaminants (e.g., metals and organics) are co-located. Reactive caps eventually lose their sorptive or chemically reactive treatment capabilities. Site monitoring would be required to determine whether the active layer should be replaced and the cap reconstructed to remain protective.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability. May not be implementable in navigation or berthing areas. May require mitigation if not habitat friendly. Decreased water depth may limit future uses of waterway and may impact flooding, stream bank erosion, navigation, and recreation.	Low-Moderate	Yes	Yes. For areas with groundwater plumes
In-Situ Treatment	Physical	Solidification/Stabilization	Effective in reducing mobility of contaminants by isolating impacted sediments from the water column and reducing the exposure to fish and other biota but will not affect the toxicity or the volume of contaminants.		Low-Moderate	Yes. Limited to areas where access and slope stability issues exist (e.g., contaminated banks behind major structures with limited access).	Yes. For limited acess areas.
		Sequestration	Limited to organic compounds and some metals. Requires site-specific studies to determine extent of use and effectiveness.	Has been demonstrated to works best with lower levels of contaminants. Easily applied in situ; may require armoring in scour areas.	Low-Moderate	Yes	Yes. For low contaminant concentrations in EMNR/MNR areas.
Removal	Dredging	Mechanical Dredging	Effective in removing stiffer or denser sediments, but requires greater effort to reduce resuspension rates and residual production. Residuals will require management strategies to achieve cleanup goals. More effective at handling debris. Environmental buckets suitable for softer materials with low debris; clamshell buckets suitable for harder, dense sediments.	Equipment is available. Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires barge to place material during operations. May require contaminant barrier during dredging activities.	Moderate	Yes	Yes
		Hydraulic Dredging	Effective in removing soft or loose sediments with high water content. Capable of lower resuspension rates at the point of dredging, as well as lower in-water residual production than mechanical dredging. Residuals will require management strategies to achieve cleanup goals.	The presence of large amounts of debris can adversely affect hydraulic dredging operations and may require pre-debris sweeps. Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires close proximity (3 - 5 miles) to land-based dewatering facility, barge dewatering facility, or CDF due to pumping limitations. Slurry separation and disposal rates can be slower than dredging rates and may limit the rate of dredging. May require contaminant barrier during dredging activities. Although in some cases diver-assisted hydraulic dredging or video-monitored dredging can be used, turbidity, safety and other technological constraints typically result in dredging being performed without visual assistance. Barge transport of hydraulically dredged material is inefficient	Moderate	Yes	No

		Specialized and Small Scale Dredge Equipment	Can be conducted close to infrastructure and within tightly restricted areas. Less residuals due to higher precision from dredging operations. May be the most effective approach for precise cleanup of a hard face, since the divers can feel the surface and adjust the excavation accordingly. Vic Vac can be useful for removing residuals from hard surface.	Production rates are much less than other removal equipment mainly due to smaller size of removal equipment a diver can handle. Seldom require contaminant release controls. Barge transport of hydraulically dredged material is inefficient. Ability of divers to maintain a desired position will be hampered by currents. Presence of logs and large debris may present dangerous conditions for diver-assisted dredging. Although divers can remove sediment from around large debris or rocks, this type of operation would be inefficient. Removal is limited to thin cuts.	High	Yes. Limited to areas with infrastructure and within tightly restricted areas.	No
	Excavation	Dry Excavation	Effective where water depths limit conventional dredging equipment.	Requires installation of sheet pile walls or cofferdam, unless performed in exposed areas during low river stages. Limited application to areas that can be reached from shore or by specialty equipment designed to work on soft unconsolidated sediments. Equipment is locally commercially available.	Low-Moderate	Yes	Yes
Confinement/ Disposal	Commercial Landfill	Hillsboro	Most effective for materials with the lowest potential to leach constituents. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Requires overland transportation. Requires elimination of free liquids for both transport and disposal. May be less favored by agencies and the public, at least for some materials, because of proximity to metropolitan Portland.	Low	Yes	No
		Northern Wasco County	Adequate capacity. May be limited as to quantity of material that can be accepted. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Requires overland transportation.	Low-Moderate	Yes	No
		Roosevelt Regional	Adequate capacity. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Accepts wet waste. Rail transportation available if a transloading facility can be sited in Portland near the river. Differences between Hazardous Waste Regulations in Oregon and Dangerous Waste Regulations in Washington need to be considered. Farther from the Site than Hillsboro or Wasco County but transportation would be mostly by barge or rail.	Moderate	Yes	Yes
		Columbia Ridge (Subtitle D)	Adequate capacity. Effective for less-contaminated, untreated dredged material from Portland Harbor or for more contaminated dredged material that has been treated to an acceptable degree. Landfill acceptance of dredged material is determined on a case-by-case basis because permit requirements are facility-specific.	Does not accept RCRA hazardous waste. Accepts wet waste. Rail transportation available if a transloading facility can be sited in Portland near the river.	Moderate	Yes	No
		Chem Waste (Subtitle C)	Redundant containment and leachate collection systems and location in an area that receives little precipitation and is removed from shallowest groundwater all contribute to long-term effectiveness.	Accepts RCRA waste. Rail transport available if a transloading facility can be sited in Portland near the river.	High	Yes	Yes
	Confined Aquatic Disposal (CAD)	Columbia River (RM 102.5)	Demonstrated effectiveness in aquatic environment. Effective containment of metals, organics, and PCBs. Can be designed to include habitat enhancement for salmonids. CADs must be engineered to withstand bioturbation, advective flux, and release of buried COPCs, propeller and/or high-flow scour, and earthquakes. Requires long-term monitoring, institutional controls, and financial commitment.	High potential for increased releases during disposal. CAD cells may be implemented with solid phase controls, such as silt curtains or berms, in order to address concerns with potential sediment transport outside the CAD area during filling events. Need for seasonal capping reduces available capacity. Potential for additional actions if CAD fails. Requires concurrence with land owner.	Moderate	No	
		Ross Island	Demonstrated effectiveness in aquatic environment. Effective containment of metals, organics, and PCBs. Can be designed to include habitat enhancement for salmonids. CADs must be engineered to withstand bioturbation, advective flux, and release of buried COPCs, propeller and/or high-flow scour, and earthquakes. Requires long-term monitoring, institutional controls, and financial commitment.	High potential for increased releases during disposal. CAD cells may be implemented with solid phase controls, such as silt curtains or berms, in order to address concerns with potential sediment transport outside the CAD area during filling events. Need for seasonal capping reduces available capacity. Potential for additional actions if CAD fails. Requires concurrence with land owner.	Moderate	No	

	Confined Disposal Facility (CDF)	Terminal 4 Slip 1	Effective if constructed and maintained properly.	60% design complete. Large capacity. Requires long-term monitoring and maintenance. Requires flood rise analysis and mitigation. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	High	Yes	Yes
		Swan Island Lagoon	Effective if constructed and maintained properly.	Large capacity. Requires long-term monitoring and maintenance. Requires flood rise analysis and mitigation. No proponent. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	High-Very High	No	
		Arkema	May not be effective due to high levels of contamination offshore of Arkema and presences of uneven bedrock surface.	Limited capacity. Requires long-term monitoring and maintenance. Construction adjacent to active river channel may result in unacceptable flood rise. RCRA regulations exclude dredged material that is subject to the requirements of Section 404 of the Clean Water Act, which would govern disposal of sediment in a disposal area within the navigable waters of the United States, from the definition of hazardous waste. Waterway impacts such as disruption of circulation patterns, impact on flooding, need for low permeability subgrade formation, and avoidance of buried utilities. In addition, because of the permanent loss of aquatic habitat, extensive mitigation would be required.	Very High	No	
	Physical	Particle Separation	Effective in reducing volume of highly contaminated material with high sand content. Increases effectiveness of dewatering dredged material. Not effective with sediments containing high concentration material with high organic content.	Readily implementable - mobile units available for quick setup and takedown time. Can be combined with soil washing to improve separation. Clean separated sand may be available for potential beneficial use (would require identification of reuse). Separation technologies available and have been used in several programs of similar size and scope. Bench scale testing to characterize the different size or density fractions is typically needed to assess feasibility.	Low	Yes	No
		Cement Solidification/ Stabilization	Bench-scale studies have added immobilizing reagents ranging from Portland cement to lime cement, kiln dust, pozzolan, and proprietary reagents. Lime has been successfully added to dredged material at other projects.	BMPs are necessary to ensure air quality impacts are minimized. Dewatering prior to cement stabilization/solidification is dependent on logistics. Mechanically dredged sediments will be saturated, but since the volumes of water produced by mechanical dredging are much more limited, blending with stabilizing agents can be done in barges on wet materials. Where hydration of the blending agent is required, some water would actually be desirable. A similar operation could be performed on hydraulically dredged sediments after they have become sufficiently dewatered (passively) to permit handling, or after they were mechanically dewatered.	Low-Moderate	Yes	Yes
		Sorbent Clay Solidification/ Stabilization	Allows adsorption of organic contaminants on to clay. Not good for volatile or flammable organics, due to vapor emission and fire concerns. Factors that influence the performance of S/S include: (1) interfering agents which prevent proper set or curing, including organics (oils, grease, phenols, chlorinated solvents) and inorganics (sulfate, phosphate); (2) gas emissions - since generally exothermic reactions, heat is generated and some volatilization of toxics can occur; and (3) final strength - decreased by organics.	BMPs are necessary to ensure air quality impacts are minimized. Lime amendment for pH control to allow for adsorption of organic contaminants	Moderate	Yes	No
		Land Farming/Composting	Limited to TPH and PAHs. Not effective for metals, PCBs, dioxin or TBT. PAHs and some SVOCs are amenable to aerobic degradation.	Large staging areas are required within close proximity to the project. BMPs may be necessary to ensure air quality impacts are minimized. If air quality impacts are expected, a contained biological PO may be more appropriate. BMPs are also necessary to control contaminant migration from runoff. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate	No	

Ex-Situ Treatment	Biological Methods	Biopiles	Limited to VOCs, SVOCs, PAHs and TPH. Not effective for metals, PCBs, TBT, or dioxins. The presence of site COCs such as PCBs, organochlorine pesticides and metals may prevent these technologies from achieving the desired cleanup levels.	Large treatment areas are required. Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate	No	
		Fungal Biodegradation	Not effective for metals, PCBs, dioxins or TBT. High concentrations of contaminants may inhibit growth.	The technology has been tested only at bench scale. No known full-scale applications.	Low-Moderate	No	
		Slurry-phase Treatment	Not effective for metals, PCBs, dioxin or TBT. PAHs and some SVOCs are amenable to aerobic degradation.	Large volume of tankage required. No known full-scale applications.	Low-Moderate	No	
		Enhanced Biodegradation	Not effective for metals, PCBs, dioxin or TBT. PAHs and some SVOCs are amenable to aerobic degradation.		Moderate	No	
	Chemical	Solvent Extraction	Successfully pilot-demonstrated at New Bedford Harbor which is contaminated with PCBs. Where metals and organics are both present in the sediment, which is typical, chemical extraction targeting organics would likely need to be coupled with other operations addressing removal/stabilization of metals. This demonstration has limited applicability to the Portland Harbor project as the goal of the pilot program was to reduce PCB concentrations to below 50 mg/kg to reduce the waste code from Subtitle C to Subtitle D; therefore, there are limited data available to determine the effectiveness of the pilot in treating to lower concentrations.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design.	High	No	
	Physical/ Chemical	Sediment Washing	Pilot-scale testing demonstrated effectiveness for metals, SVOCs and PCBs in sediments. Limited data suggests not effective for TBT. High recalcitrant (e.g., PCBs) contaminant concentrations, increased percentage fines, and high organic content increases overall treatment costs.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design. For some sediment washing methods, process residence time is limited to the time required for the slurry to be pumped/flow through the various unit operations. Multiple cycles may be required to achieve sufficient contaminant reduction in some cases. Would require upland processing space, storage capacity for dredged sediments, wastewater treatment, and discharge. Treated residuals would still require disposal.	Moderate	Yes	No
	Thermal Methods	Incineration	High temperatures result in generally complete decomposition of PCBs and other organic chemicals. Effective across wide range of sediment characteristics. Not effective for metals.	Requires air pollution control device. Mobile treatment may be used, if available, and may be more cost effective than offsite thermal treatment if the treatment volumes are high enough. Nearest existing, permitted facility is greater than 500 miles from project. High energy consumption. Potential for dioxin generation is a concern. Public concern may make implementability challenging.	Very High	No	
		High Temperature Thermal Desorption	Target contaminants are SVOCs, PAHs, PCBs, TBT, and pesticides. Metals are not destroyed. Especially effective with high levels of PCBs (>50 ppm).	Requires air pollution control device. Technology readily available as mobile units that would need to be set up at a fixed location in lose proximity to the contaminated sediments. High energy consumption; however, costs may be offset through the sale/use of generated power. Pre-permitting consultation and acceptance of BU products is crucial to economic viability of PO.	High	No	
		Low Temperature Thermal Desorption	Effective for SVOCs and PAHs. May have limited effectiveness for PCBs. Metals not destroyed. Effectiveness demonstrated at other sediment remediation sites. Fine-grained sediment and high moisture content will increase retention times. Widely-available commercial technology for both on-site and off-site applications. Acid scrubber will be added to treat off-gas.	Requires air pollution control device. Fine-grained sediment and high moisture content will increase retention times. Vaporized organic contaminants that are captured and condensed need to be destroyed by another technology. The resulting water stream from the condensation process may require further treatment. Widely-available commercial technology for both on-site and off-site applications.	Low	No	
		Vitrification	Thermally treats PCBs, SVOCs, TBT, and stabilizes metals. Successful bench-scale application to treating contaminated sediments in Lower Fox River, and in Passaic River.	Not commercially available or applied on similar site and scale.	Moderate-High	No	

LWG
LOWER WILLAMETTE GROUP

Chairperson: Bob Wyatt, NW Natural
Treasurer: Frederick Wolf, DBA, Legacy Site Services for Arkema

February 12, 2015

Kristine Koch
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, WA 98101-3140

Re: EPA Proposed Final Feasibility Study Section 1 (Lower Willamette River, Portland Harbor Superfund Site, USEPA Docket No: CERCLA-10-2001-0240)

Kristine:

EPA transmitted to the LWG via email on January 9, 2015 a version of Feasibility Study (FS) Section 1 with the file name "2015-01-09 Proposed Final Portland Harbor FS Section 1.docx". This file included additional revisions made by EPA since LWG last submitted detailed edits to EPA on the previous version on September 17, 2014. This file appears to also include additional revisions made to the document since the last version provided by EPA to LWG on December 17, 2014. The LWG has reviewed this most recent version of FS Section 1 and is providing the attached file with our comments. The file presents redlined text and embedded comments to facilitate your review. EPA's changes since September 17, 2014 are shown as redline of one color, and the LWG suggested edits and comments are shown with a second color. The LWG comments fall into three categories that are noted at the start of each comment in all capital letters as follows:

- Comments on Recent Text – These are comments regarding EPA's most recent changes as noted by the redlines discussed above. The LWG has not previously been provided an opportunity during the FS Section 1 review process to provide input on these most recent changes. We request that EPA consider the LWG input on these most recent changes to FS Section 1 by EPA.
- New Comments – These are comments regarding text that was not recently modified by EPA, but the LWG believes will make the text more factually accurate and should be fully considered by EPA.
- Reiterated Comments – These are comments similar to some past LWG comments that EPA appears to have considered and not adopted. In most cases, the reiterated comments offer an alternate proposal to the previously identified issue that the LWG believes would still improve the accuracy of the text and that EPA should fully consider.

In addition, the LWG reiterates that the information discussed in the LWG comment letters dated August 29, 2014 and January 2, 2015 provides necessary scientific and legal support for EPA's remedy selection and should be included in Section 1. Federal regulations state that "the development and evaluation of alternatives [in the FS] shall reflect the scope and complexity of the remedial action under consideration and the site problems being addressed." 40 CFR 300.430(e)(1). Deletion of a robust conceptual site model and site-specific conditions, for example, results in a FS that does not reflect the "scope and complexity" of the remedial action and site problems and does not provide appropriate development and evaluation of alternatives. We attach the January 2, 2015 letter again, and to the extent EPA has not made the revisions requested, then those comments remain relevant and should be incorporated in Section 1.

Finally, as noted by some of the attached comments, it is our understanding that EPA used preliminary information from DEQ during DEQ's development of the Source Control Summary Report (SCSR) for Portland Harbor to develop Section 1. DEQ subsequently issued the report in November 2014. The LWG is reviewing the FS Section 1 subsections on groundwater and riverbank sources for consistency with the now available SCSR. The LWG will soon submit to EPA additional detailed comments on FS Section 1 regarding the consistency between these two documents and the accuracy of the source text in FS Section 1.

Please let me know if you have any questions about these comments.

Sincerely,

Bob Wyatt

cc:

Sean Sheldrake, U.S. Environmental Protection Agency, Region 10
Confederated Tribes and Bands of the Yakama Nation
Confederated Tribes of the Grand Ronde Community of Oregon
Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Reservation of Oregon
Nez Perce Tribe
Oregon Department of Fish & Wildlife
United States Fish & Wildlife
Oregon Department of Environmental Quality
LWG Legal
LWG Repository

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1.0 INTRODUCTION

This report presents the Feasibility Study (FS) for the Portland Harbor Superfund Site in Portland, Oregon (**Figure 1-1**). Portland Harbor was evaluated and proposed for inclusion on the National Priorities List (NPL) pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund), 42 U.S.C. §9605, by the U.S. Environmental Protection Agency (EPA) and formally listed as a Superfund Site in December 2000. The lead agency for this site is EPA.

The basis of this FS is environmental data collected and compiled by the Lower Willamette Group (LWG) and other parties since the inception of the Portland Harbor Remedial Investigation and Feasibility Study (RI/FS) in 2001[1]. The LWG is performing the remedial investigation (RI) and FS for the Portland Harbor Superfund Site (Site) pursuant to an EPA Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (AOC; EPA 2001, 2003, 2006). Oversight of LWG's Portland Harbor RI and FS is being provided by EPA with support from Oregon Department of Environmental Quality (DEQ). EPA has entered into a Memorandum of Understanding (MOU) with DEQ, six federally recognized tribes, two other federal agencies, and one other state agency[2], who have all participated in providing support in the development of this document.

The RI (insert citation) has been completed and has characterized the Site sufficiently to define the nature and extent of the source material and the Site-related contaminants. Baseline ecological and human health risk assessments (Windward 2013; Kennedy Jenks 2013) have also been completed. The site characterization and baseline risk assessments are sufficient to complete the FS for the Site.[3]

This FS focuses on approximately ten miles of the lower Willamette River from River Mile (RM) 1.9 (at the upriver end of the Port of Portland's Terminal 5) to RM 11.8 (near the Broadway Bridge), sometimes referred to as the "site" in this FS for convenience. The terms site, harbor-wide, and site-wide used in this FS generally refer to the sediments, pore water, and surface water within this reach of the lower Willamette River, not to the upland portions of the Portland Harbor Superfund Site.

[1] Upland source control efforts, including site-specific upland source control studies and implementation of source control measures, are performed under the oversight of the Oregon Department of Environmental Quality and are not within the scope of the Agreement and Order on Consent and Statement of Work for the in-water portion of the Site.

[2] Government parties that signed the MOU include: the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Grand Ronde Community of Oregon, the Confederated Tribes of Siletz Indians, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Nez Perce Tribe, the National Oceanic and Atmospheric Administration, the U.S. Department of the Interior, and the Oregon Department of Fish and Wildlife.

[3] Although this section identifies many specific sources of contamination, neither this section nor this report generally is intended as an exhaustive list of current or historical sources of contamination.

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This FS is consistent with CERCLA, as amended (42 United States Code [U.S.C.] 9601 et seq.), and its regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300), commonly referred to as the National Contingency Plan (NCP) and was prepared in accordance with EPA guidance. Guidance documents used in preparing this FS include:

- *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988)
- *Clarification of the Role of Applicable or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA* (EPA 1997a)
- *Rules of Thumb for Superfund Remedy Selection* (EPA 1997b)
- *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (EPA 2002)
- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005)
- *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000)
- *Technical Resource Document on Monitored Natural Recovery* (EPA 2014)

1.1 PURPOSE AND ORGANIZATION OF REPORT

The purpose of the FS is to identify, develop, screen, and evaluate a range of remedial alternatives to reduce risks from contaminated media to acceptable levels and to provide the regulatory agencies with sufficient information to select a remedy that meets the requirements established in the NCP. This FS report is comprised of four sections as described below.

- Section 1 – Introduction: Provides a summary of the Site RI, including Site description, Site history, nature and extent of contamination, contaminant fate and transport, and baseline human health and ecological risks.
- Section 2 - Identification and Screening of Technologies: Develops remedial action objectives (RAOs), develops preliminary remediation goals (PRGs) for addressing human health and ecological risks posed by contaminants in sediment and tissue, develops general response actions (GRAs) for each medium of interest, identifies areas of media to which general response actions might be applied, identifies and screens remedial technologies and process options, and identifies and evaluates technology process options to select a representative

process for each technology type retained for consideration.

- Section 3 - Development and Screening of Alternatives: Presents a range of remedial alternatives developed by combining the feasible technologies and process options. The alternatives are then refined and screened to reduce the number of alternatives that will be analyzed in detail. This screening aids in streamlining the feasibility study process while ensuring that the most promising alternatives are being considered.

- Section 4 - Detailed Analysis of Alternatives: Provides the detailed analysis of each alternative with respect to the following seven criteria: 1) overall protection of human health and the environment, 2) compliance with ARARs, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, and 7) cost. In addition to the detailed analysis, a comparative analysis of remedial action alternatives is also presented in this section. EPA also recognizes that this site affects many stakeholders, including communities with environmental justice concerns who live along the river or who live elsewhere but use the river. The evaluation of remedial alternatives considers impacts to these communities.

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The Willamette River originates within Oregon in the Cascade Mountain Range and flows approximately 187 miles north to its confluence with the Columbia River, and is one of 14 American Heritage Rivers in the country. It is the 19th largest river in the United States, and drains 11.7 percent of the State of Oregon. As Oregon's major port and population center, the lower Willamette River sees a great variety of uses including shipping, industrial, fishing, recreational, natural resource, and other uses. The lower reach of the Willamette River from RM 0 to approximately RM 26.5 is a wide, shallow, slow moving segment that is tidally influenced with tidal reversals occurring during low flow periods as far upstream as RM 15. The river segment between RM 3 and RM 10 is the primary depositional area of the lower Willamette River system. The lower reach has been extensively dredged to maintain a 40-foot deep navigation channel from RM 0 to RM 11.7.

The Portland Harbor RI/FS Study Area is located along the lower reach of the lower Willamette River in Portland, Oregon known as Portland Harbor (**Figure 1-1**). The RI/FS Study Area extends from RM 1.9 to 11.8 and up to a vertical elevation of 13.3 feet North American Vertical Datum of 1988 (NAVD88). While the harbor area is extensively industrialized, it occurs within a region characterized by commercial, residential, recreational, and agricultural uses. Land use along the lower Willamette River in the harbor includes marine terminals, manufacturing, and other commercial operations, as well as public facilities, parks, and open spaces. **Figures 1.2-1a** through **1.2-1d** illustrate land use zoning within the lower Willamette River as well as waterfront land ownership. The State of Oregon owns certain submerged and submersible lands underlying navigable and tidally influenced waters. The ownership of submerged and submersible lands is complicated and has changed over time (**Figure 1.2-2**).

Today, the Willamette River is noticeably different from the river prior to industrial development that commenced in the mid to late 18th century. Historically, the Willamette River was wider with more sand bars and shoals and flow volumes were subject to greater fluctuation. The main river now has been redirected and channelized, several lakes and wetlands in the lower floodplain have been filled and agricultural lands converted to urban or industrial areas. The end result is a river that is deeper and narrower than it was historically with higher banks that prevent the river from expanding during high-flow events. The Willamette River channel, from the Broadway Bridge (RM 11.6) to the mouth (RM 0), currently varies in width from 600 to 1,900 feet. Further, the installation of a series of dams moderate fluctuations of flow in the lower Willamette River.

Little, if any, original shoreline or river bottom exists that has not been modified by the above actions, or as a result of them. Much of the shoreline has been raised, filled, stabilized, and/or engineered and contains overwater piers and berths, port terminals and slips, stormwater and industrial wastewater outfalls and combined sewer overflows (CSOs), and other engineered features. Constructed structures, such as wharfs, piers, floating docks, and pilings, are especially common in Portland Harbor where urbanization and industrialization are most prevalent. These structures are built largely to accommodate or support shipping traffic within the river and to stabilize the riverbanks for urban development. Constructed structures are clearly visible in the aerial photos provided in **Figures 1.2-3a** through **1.2-3n.**

Armoring to stabilize banks covers approximately half of the harbor shoreline, which is integral to the operation of activities that characterize Portland Harbor. Riprap is the most common bank-stabilization measure. However, upland bulkheads and rubble piles are also used to stabilize the banks. Seawalls are used to control periodic flooding as most of the original wetlands bordering the Willamette in the Portland Harbor area have been filled. Some riverbank areas and adjacent parcels have been abandoned and allowed to revegetate, and beaches have formed along some modified shorelines due to relatively natural processes.

A federal navigation channel, maintained to a depth of -40 feet with an authorized depth of -43 feet, extends from the confluence of the lower Willamette River with the Columbia River to RM 11.7 (**Figure 1.2-4**). The lower Willamette River federal navigation project was first authorized in 1878 to deepen and maintain parts of the Columbia River and lower Willamette River with a 20-foot minimum depth. The depth of the navigation channel has been deepened at various intervals since that time (i.e., increased to 25 feet in 1899, 30 feet in 1912, 35 feet in 1930, and 40 feet in 1962). Container and other commercial vessels regularly transit the river. Certain parts of the river require periodic maintenance dredging to keep the navigation channel at its maintained depth. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor.

Development of the river has resulted in major modifications to the ecological function of the lower Willamette River. However, a number of species of invertebrates, fishes, birds, amphibians, and mammals, including some protected by the Endangered Species Act (ESA), use habitats that occur within and along the river. The river is also an important rearing site and pathway for migration of anadromous fishes, such as salmon and lamprey. Various recreational fisheries, including salmon, bass, sturgeon, crayfish, and others, are active within the lower Willamette River. A detailed description of ecological communities in Portland Harbor is presented in the Baseline Ecological Risk Assessment (BERA) provided as Appendix G of the RI Report.

1.2.2 Site History

Since the late 1800s, the Portland Harbor section of the lower Willamette River has been extensively modified to accommodate a vigorous shipping industry. Modifications include redirection and channelization of the main river, draining seasonal and permanent wetlands in the lower floodplain, and relatively frequent dredging to maintain the navigation channel. Historically, the Willamette was wider, had more sand bars and shoals, and fluctuated greatly in volume.

The lower Willamette River and its adjacent upland areas have been used for industrial, commercial, and shipping operations for over a century. Commercial and industrial development in Portland Harbor accelerated in the 1920s and again during World War II, which reinvigorated industry following the Great Depression. Before World War II, industrial development primarily included sawmills, manufactured gas production (MGP), bulk fuel terminals, and smaller industrial facilities. During World War II, a considerable number of ships were built at military shipyards located in Portland Harbor. Additional industrial operations located along the river in the post-World War II years included wood-treatment, agricultural chemical production, battery processing, ship loading and unloading, ship maintenance, repair and dismantling, chemical manufacturing and distribution, metal recycling, steel mills, smelters, foundries, electrical production, marine shipping and associated operations, rail yards, and rail car manufacturing. Many of these operations continue today. Contaminants associated with these operations were released from various sources and migrated to the lower Willamette River. The long history of industrial and shipping activities in the Portland Harbor, as well as agricultural, industrial, and municipal activities upstream of Portland Harbor, has contributed to chemical contamination of surface water and sediments in the lower Willamette River.

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1.2.2.1 Investigation History

Many environmental investigations by private, state, and federal agencies have been conducted, both in the lower Willamette River and on adjacent upland properties, to characterize the nature and extent of contamination in the river, as well as to identify potential sources of contaminants that could continue to enter the river. Investigations have been conducted in Portland Harbor from the 1920s to the present, with most studies being performed from the late 1970s through the present. Nearly 700 documents and data sets were obtained that address conditions in the lower Willamette River. Specific historical and recent studies and data sets were selected for inclusion in the data set used to characterize and evaluate the Study Area in the RI and FS reports.

Site data were collected by the LWG during four major rounds of field investigations between 2001 and 2010 to complete the RI. The investigations were often timed around varying river stages, river flows, and storm events. The field investigations first began in 2001 in the Initial Study Area (ISA) as defined by the AOC, Statement of Work (SOW), and Programmatic Work Plan as RM 3 to RM 9. As the studies commenced, the Study Area was expanded from RM 1.9 to RM 11.8, as well as a portion of the Multnomah Channel. Studies conducted by the LWG also included areas downriver of the Study Area to the confluence with the Columbia River at RM 0 and upriver to RM 28.4. Surface and subsurface sediment samples, sediment trap samples, riverbank sediment and soil samples, surface water samples, stormwater and stormwater solids samples, groundwater samples, transition zone water (TZW) samples, and biota/tissue samples were collected and analyzed during the various investigations conducted.

1.2.2.2 Upland Source Control Measures

Identifying current sources of contamination to the Study Area and eliminating or minimizing these pathways where possible is critical for remedy effectiveness as well as evaluating the recontamination potential of a cleanup. In February 2001, DEQ, EPA, and other governmental parties signed an MOU agreeing that DEQ, using state cleanup authority, has lead technical and legal responsibility for identifying and controlling upland sources of contamination that may impact the river (e.g., sediment, groundwater, TZW, and/or surface water). Currently, DEQ is investigating or directing source control work at over 90 upland sites in Portland Harbor and evaluating investigation and remediation information at more than 80 other upland sites in the vicinity (ODEQ 2014). Additionally, DEQ is working with the City of Portland under an Intergovernmental Agreement to identify and control upland sources draining to the Study Area through 39 city outfalls, and with the Oregon Department of Transportation on controlling sources in highway and bridge runoff drained to the Study Area (City of Portland 2012).

The City prepared a CSO Management Plan (City of Portland 2005) with recommendations to address wet weather overflow discharges, including implementation of storage and treatment facilities along the Willamette River ("Big Pipe project") to control the CSO discharges. The primary means for increasing the storage capacity was through construction of the West Side Tunnel (completed in 2006) and the East Side Tunnel (completed in 2011).

The cleanup of known or potentially contaminated upland sites is tracked in DEQ's Environmental Cleanup Site Information (ECSI) database, which is available online at http://www.deq.state.or.us/lq/ECSI/ecsi.htm, and source control efforts are summarized in DEQ's Portland Harbor Upland Source Control Milestone and Summary Report (http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm).

Figures 1.2-5a through **1.2-5e** graphically display the status of DEQ source control evaluations as of 2014 for various sites along the Study Area by potential release/migration pathways to the river. An important overall assumption of the FS is that upland sources in Portland Harbor will be controlled sufficient to achieve project goals through the DEQ process.

1.2.2.3 Early Action Sites

Within Portland Harbor, separate orders have been executed by EPA with various parties for five specific sites. These sites are:

1. Terminal 4 – conducted by the Port of Portland
2. Gasco – conducted by NW Natural
3. Gasco and Siltronic – conducted by NW Natural and Siltronic
4. Arkema – conducted by Arkema
5. RM 11 E (Supplemental RI/FS) – conducted by Glacier Northwest, Inc., Cargill, Inc., PacifiCorp, CBS Corporation, DIL Trust, and City of Portland

These projects are currently in various stages of completion as described below.

- **Terminal 4** – The Port of Portland has been implementing a removal action at Terminal 4. A Phase I Abatement Measure was completed in 2008 that consisted of remediation and maintenance dredging of approximately 13,000 cubic yards of sediment. Remediation consisted of dredging 6,315 cubic yards of contaminated sediment and placing it in an off-site disposal facility, isolating contaminated sediment in the back of Slip 3 with a cap made of organoclay-sand mix, and stabilizing the bank along Wheeler Bay.

- **Gasco** – A removal action was conducted at the Gasco site between August and October 2005. Approximately 15,300 cubic yards of a tar-like material and tar-like contaminated sediment were removed by dredging from the riverbank and nearshore area adjacent to the Gasco facility and disposed of off-site. After the removal action, an organoclay mat was placed along an upper-elevation band of the shoreline dredge cut. This mat was secured with placement of an overlying sand cap and quarry spalls. A one foot thick sand cap and 0.5 foot of erosion protection gravel was placed over the remainder of the removal area (0.4 acres). Approximately 0.5 foot of a "fringe cap" of sand material was placed over 2.3 acres of the area surrounding the removal area.

- **Gasco and Siltronic** – NW Natural and Siltronic are conducting site characterization and design evaluations for the area adjacent to their two facilities. Under the order, NW Natural and Siltronic have agreed to perform further characterization, studies, analysis and preliminary design that will lead ultimately to a final remedy at the Gasco Sediments Site. Conducting this work will facilitate construction of the final remedy to begin expeditiously following issuance of a Record of Decision (ROD) for the Portland Harbor Superfund Site. The remedial action for the NW Natural and Siltronic sediments will be implemented in coordination with and following completion of any necessary upland NW Natural and Siltronic source control work being managed by DEQ.

- **Arkema** – Under an AOC with EPA, Arkema conducted additional site characterization and preliminary design evaluations for a planned Removal Action.

- **River Mile 11 East -** A group of Respondents, collectively known as the RM 11E Group (includes Glacier Northwest, Inc., Cargill, Inc., PacifiCorp, CBS Corporation, DIL Trust, and City of Portland), entered into an AOC to perform supplemental RI/FS work in support of preliminary design activities.

In addition, a near-shore sediment removal adjacent to the BP Arco Bulk Terminal in 2007-08 under DEQ oversight resulted in 12,300 cubic yards of petroleum-contaminated soil and sediment being removed and disposed of off-site, and replaced with clean fill in conjunction with the installation of a new steel sheet-pile seawall along the entire riverbank of the BP Arco Bulk Terminal property.

1.2.3 Nature and Extent of Contamination

Due to the large number of contaminants detected at the Study Area in various media, the nature and extent of contamination focuses on specific contaminants or groups of contaminants selected by evaluating several criteria discussed in Section 5.1 of the RI.

Fourteen indicator contaminants were discussed in detail in Section 5 of the RI report based on frequency of detection, ease of cross media comparisons, co-location with other contaminants, widespread sources, and similar chemical structures and properties. Information regarding the remaining contaminants is provided in Appendix D of the RI. The nature and extent of indicator contaminants in sediment and surface water are summarized in the following sections. As discussed in Section 5.1 of the RI, additional contaminants beyond the indicator contaminants presented in the RI (and summarized in this section) are present at the site at concentrations that may pose unacceptable risk to human health and the environment. Section 2.2.1 of the FS identifies the contaminants of concern (COCs) selected for the Portland Harbor Superfund Site and discusses the process for selecting the COCs.

Groundwater COCs are summarized in the subsections below because this information may affect decisions about sediment caps within the Site. The COCs in river banks are also summarized because EPA may include some bank areas above elevation 13.3 feet NAVD88 within the Portland Harbor Site based on future site-specific determinations.

1.2.3.1 Sources

Historical and current locations of various industrial facilities identified along the lower Willamette River are provided by industrial sector in **Figures 1.2-6a** through **1.2-6j**. The approximate location of facilities is shown on the maps; however, the actual extent of historical and current facilities/operations is not shown. Detailed information regarding historic and current sources of contamination in the lower Willamette River is provided in Section 4 of the RI Report.

Each of these industrial sectors is typically associated with the use of various chemicals. The contaminants are dependent upon the activities conducted, but could include the following:

Industrial Sector	Common Industry Contaminants
Ship Building, Dismantling, and Repair	Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), metals (e.g., Cu, Cr, Pb, Hg, Zn), phthalates, butyltins
Wood Products and Wood Treating	VOCs, SVOCs, TPH, benzene, PAHs, metals (e.g., As, Cr, Cu, Zn), pesticides, fungicides, biocides, borates, pentachlorophenol, creosote, acid/alkaline wastes, dioxins
Chemical Manufacturing and Distribution	Vary depending on the operations, but chemical manufacturing known to have occurred within Portland Harbor includes pesticides, herbicides, VOCs, SVOCs, dioxins/furans, metals, PCBs, solvents, acid/alkaline wastes, benzene, TPH, and PAHs
Metal Recycling, Production, and Fabrication	VOCs, SVOCs, TPH, PCBs, PAHs, heavy metals, asbestos, cyanide, phthalates, fuel and fuel additives, battery acid, oil and grease, lubricants, paint pigments or additives, ionizing radioactive isotopes, transmission and brake fluids, lead acid, antifreeze, benzene, chemical residue, heating oil, solvents
Manufactured Gas Production	VOCs including benzene, toluene, ethylbenzene, and xylenes (BTEX), SVOCs, PAHs, TPH, metals, and cyanide

Electrical Production and Distribution	PCBs, TPH, and PAHs
Bulk Fuel Distribution and Storage, and Asphalt Manufacturing	VOCs (benzene), SVOCs, PAHs, TPH, metals, gasoline additives (methyl tert-butyl ether [MTBE], ethylene dibromide [EDB], ethylene dichloride [EDC])
Steel Mills, Smelters, and Foundries	Metals, TPH, PAHs, PCBs, fuel additives, chlorinated VOCs
Commodities Maritime Shipping and Associated Marine Operations	Spillage of raw materials during transport to and from vessels, butyltins, metals, TPH, fuel additives, chlorinated VOCs
Rail Yards	VOCs, SVOCs, TPH, PCBs, and heavy metals

Contaminants released during industry operations and/or other activities to the air, soil, groundwater, surface water, and/or impervious surfaces can potentially migrate to the lower Willamette River via the following pathways: direct discharge, overland transport, groundwater, riverbank erosion, atmospheric deposition, overwater activities, and upstream watershed.

One key migration pathway for contaminants from these various industries to migrate to the river was through direct discharge via numerous public and private outfalls, including storm drains and CSOs, which are located along both shores of the lower Willamette River in the metropolitan area. In the early 1900s, rivers in the United States were generally used as open sewers, which was also true for the Willamette (Carter 2006). The process water from a variety of industries, including slaughterhouses, chemical plants, electroplaters, paper mills, and food processors, was discharged directly into the river. In the 1950s, municipal conveyance systems included interceptors and associated facilities were installed to reduce the volume of untreated sewage discharging to the Willamette from the City of Portland and regulatory actions in the 1960s and 1970s, such as the Clean Water Act, gradually reduced the direct discharge of waste to the Willamette River.

Historical releases from upland or overwater activities within the Study Area likely contributed to the majority of the observed contaminant distribution in sediments within the Study Area. The majority of current contaminant pathways to the river (soil erosion, groundwater, and stormwater) from upland sources are a result of historical operational practices, spills, and other releases.

In addition, point and nonpoint discharges within the Willamette River Basin are potential sources of contamination in sediment, surface water, and biota in the Study Area. Contaminants in discharges and runoff from diverse land uses in the basin eventually enter the river upstream of the Study Area. Contaminant loading from sediment transport and water from upstream areas throughout the last century also contributed to the conditions currently observed in the Study Area.

1.2.3.2 Sediment

Sediment samples were collected from the Study Area for consideration in the FS. Much of the sampling was conducted by the LWG under the terms of the AOC and consistent with EPA approved work plans. Sample locations were biased toward areas of known or suspected contamination based on existing information. Additional sampling was conducted both upstream and downstream of the Study Area. Summary statistics of surface and subsurface sediment results for the contaminants presented above are provided in **Table 1.2-1**. Generally, concentrations of the contaminants were greater in subsurface sediment samples relative to surface samples, confirming that historical inputs were greater than current inputs. However, there are noted areas within the Study Area where surface concentrations are greater than subsurface concentrations likely reflecting more recent releases and/or disturbance of bedded sediments.

PCBs

With few exceptions, the highest PCB concentrations in surface sediment are present in nearshore areas outside the navigation channel and proximal to currently known or suspected sources (**Figure 1.2-7a**). Similar spatial and concentration trends are observed for subsurface sediments (**Figure 1.2-7b**). Total PCB concentrations are typically greater in the subsurface than in surface sediments, indicating PCB sources are primarily historical. Overall, surface sediment PCB concentrations in the Study Area are greater than those in the upriver (upstream of Ross Island) and downstream (main stem of the lower Willamette River downstream of RM 1.9 and Multnomah Channel) reaches.

Dioxins/Furans

Total polychlorinated dibenzo-p-dioxins/furans (PCDD/Fs) were detected at several locations along the eastern and western nearshore zones and in Swan Island Lagoon (**Figure 1.2-8a**). Limited surface PCDD/F data are available; thus, spatial resolution is somewhat limited, especially in the navigation channel. Total PCDD/F concentrations in the subsurface are generally greater than that observed in surface sediments (**Figure 1.2-8b**). The higher concentrations generally observed in subsurface sediment relative to concentrations in surface sediment are indicative of a primarily historical input of these contaminants to the Study Area.

DDx

The highest reported DDx[4] concentrations in surface sediments are present in localized areas in the western nearshore zones between RMs 6.3 and 7.5 (**Figure 1.2-9a**). DDx concentrations are typically greater in the subsurface than in the surface layer, indicating DDx sources are primarily historical (**Figure 1.2-9b**). The concentrations of DDx in surface sediments are greater in the Study Area than those in the upriver, downtown, Multnomah Channel, and downstream reaches.

Total PAHs

[4] DDx is the sum of 2,4'- and 4,4'-dichloro-diphenyl-dichloroethane (DDD), 2,4'- and 4,4'-dichloro-diphenyl-dichloroethene (DDE), and 2,4'- and 4,4'-dichloro-diphenyl-trichloroethane (DDT).

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The highest reported concentrations of total PAHs in surface sediments generally occur in the western nearshore zone downstream of RM 6.8, and on the east side at approximately RM 4.5 (**Figure 1.2-10a**). Total PAH concentrations are generally higher in subsurface sediments within the Study Area as a whole, pointing to higher historical inputs to the Study Area (**Figure 1.2-10b**). Within the Study Area, total PAHs in sediment are generally dominated by high molecular weight PAHs (HPAHs). Surface sediments from the western nearshore zone appeared to exhibit higher proportions of low molecular weight PAHs (LPAHs) than sediments from the eastern nearshore zone and the navigation channel, but follow the general trend of HPAH dominance. Subsurface sediments generally exhibit similar PAH profiles to the surface sediments.

Bis(2-ethylhexyl) phthalate
The highest reported concentrations of bis(2-ethylhexyl) phthalate were observed in samples collected in surface and subsurface sediment from the eastern nearshore in Swan Island Lagoon, between RM 3.8 and 4.1, and in the International Terminals Slip (**Figures 1.2-11a and 1.2-11b**).

Total Chlordanes
The highest reported concentrations of total chlordanes were observed along the western nearshore zone between approximately RM 7 and 9 (**Figure 1.2-12a**). Total chlordane concentrations are generally higher in subsurface sediments within the Site, pointing to higher historical inputs to the Site (**Figure 1.2-12b**).

Aldrin and Dieldrin
Aldrin and dieldrin, have similar chemical structures and are discussed together here because aldrin readily undergoes biotic and abiotic transformation to dieldrin. The highest reported concentrations of aldrin were observed in the western nearshore zone from RM 6.8 to RM 7 and from RM 8.6 to RM 8.8 (**Figures 1.2-13a)**. The highest reported surface concentrations of dieldrin were observed in Swan Island Lagoon and in the western nearshore zone from RM 8 to 9 (**Figure 1.2-14a**). Aldrin and dieldrin concentrations are higher in subsurface sediments than surface sediments within the Site (**Figures 1.2-13b and 1.2-14b**), pointing to higher historical inputs to the Study Area.

Metals
The highest reported arsenic concentrations were reported in several locations in the eastern nearshore at RM 2.3, RM 5.6, RM 7.2, near the mouth of Swan Island Lagoon, and in the western nearshore area at RM 6.8, RM 8.6, and RM 10.2 (**Figure 2.1-15a**). Arsenic concentrations are generally greater in the surface sediments than in subsurface sediments within the Study Area (**Figure 1.2-15b**).

The highest reported chromium concentrations were observed in the eastern nearshore zone at RM 2.1-2.4, RM 3.7-4.4, RM 5.6-5.9, and in Swan Island Lagoon, and in the western nearshore zone at RM 6-6.1, RM 6.8-6.9, and RM 8.8-9.2 (**Figure 2.1-16a**). Chromium concentrations are generally greater in the surface sediments than in subsurface sediments within the Study Area (**Figure 1.2-16b**).

The highest surface and subsurface copper concentrations were observed in the eastern nearshore zone at RM 2.1-2.4, RM 3.7-4, RM 5.5-6.1, RM 11.1-11.3, and Swan Island Lagoon, and in the western nearshore zone from RM 4.3 through 10.4 (**Figure 1.2-17a**). Copper concentrations are generally similar in surface and subsurface sediments in the Study Area (**Figure 2.1-17b**).

The highest surface sediment zinc concentrations were found in the eastern nearshore zone at RM 4-4.6, RM 5.6, and RM 6.7, and the western nearshore zone between RM 8 and 9.2 (**Figure 2.1-18a**). The highest subsurface concentrations of zinc were found in the western nearshore zone at RM 9-9.2 and in Swan Island Lagoon (**Figure 1.2-18b**). Zinc concentrations are generally similar in the surface sediments and subsurface sediments within the Study Area.

Tributyltin Ion

The highest concentrations of tributyltin were reported in surface sediment near the eastern nearshore zone at RM 3.7, RM 7.5, and in Swan Island Lagoon (**Figure 2.1-19a**). The highest subsurface concentrations of tributyltin are found in the eastern nearshore zone between RM 7 and RM 8, and in Swan Island Lagoon (**Figure 2.1-19b**). Concentrations are generally higher in subsurface than surface sediments within the Site, pointing to primarily historical inputs to the Study Area.

1.2.3.3 Surface Water

Concentrations of contaminants in surface water samples varied both spatially and with river flow. Surface water sample locations with the highest reported contaminant concentrations are as follows:

River Mile	River Location	Sample ID	Contaminants
MC	Transect	W027	PCDD/Fs, aldrin, copper
2	East	W001	PCBs, DDx
	West	W002	chlordanes
	Transect	W025	PCBs, BEHP, aldrin
3	International Slip	W004	PCBs
	East	W028	PCBs
4	West	W029	BEHP, chlordanes
5	East	W030	PCBs, DDx, chlordanes
6	East	W013, W014, W032	PCBs, PCDD/Fs

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	West	W015, W031	PCBS, PCDD/Fs, DDx, PAHs, chlordanes, aldrin, dieldrin, copper
	Transect	W011	PCDD/Fs, BEHP, aldrin
7	West	W016, W033	PCBs, PCDD/Fs, DDx
8	West	W019, W036	PCBs, PAHs, BEHP
9	West	W022, W037	DDx, zinc
11	Transect	W023	PCDD/Fs, chlordanes, copper
16	Transect	W024	BEHP, copper

RM 7E, RM 8E, RM 9E, and RM 10 were not sampled.
BEHP - bis(2-ethylhexyl) phthalate

Concentrations of contaminants in surface water within the Study Area are generally higher than those entering the upstream limit of the Study Area (W024 at RM 16) under all flow conditions. The highest contaminant concentrations in surface water within the Site were found near known sources. At the downstream end of the Study Area, RM 2 (W001, W002, W025) and Multnomah Channel (W027), concentrations of total PCBs, dioxin/furans, DDx, BEHP, chlordanes, and aldrin in surface water are greater than concentrations entering the Study Area, which indicates contamination from Portland Harbor is being transported downstream to the Columbia River.

1.2.3.4 Groundwater

Figure 1.2-20a through Figure 1.2-20h and **Figure 1.2-21** (inset of the Doane Lake area) show the nature and extent of known contaminated groundwater plumes currently or potentially discharging to the river. Cleanup of contaminated groundwater is being managed by DEQ under an MOU with EPA (see 1.2.2.2, above). The following provides a discussion of the groundwater plumes presented in **Figures 1.2-20a through 1.2-20h** and **1.2-21.** Additional information on these sites is available in DEQ's ECSI database.

East Side of Willamette River

RM 2
Evraz Oregon Steel Mill (ESCI Site ID 141) –Contaminants are manganese and arsenic.

RM 3.5
Time Oil (ECSI Site ID 170) – Contaminants are pentachlorophenol, arsenic, gasoline- and diesel-range hydrocarbons.

Premier Edible Oil (ECSI Site ID 2013) – Contaminants are TPH (diesel-range hydrocarbons), manganese, and arsenic.

Schnitzer Steel Industries (ECSI Site ID 2355) – A halogenated VOC plume is known to be discharging to the river. Contaminants include cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), and trichloroethene (TCE).

RM 4.5
Terminal 4 Slip 3 (ECSI Site ID 272) – Contaminants include TPH (diesel-range hydrocarbons).

RM 6
McCormick & Baxter Creosote Co. (ECSI Site ID 74) – Contaminants include pentachlorophenol, PAHs, arsenic, chromium, copper, and zinc.

RM 11
Tarr Oil (ECSI Site ID 1139) – A halogenated VOC plume is originating at the facility and likely discharges to the river. Contaminants include cis-1,2-DCE, PCE, TCE, and vinyl chloride.

West Side of Willamette River

RM 4
Kinder Morgan Linnton Bulk Terminal (ECSI Site ID 1096) – A TPH plume is located onsite and has released to the river. Contaminants include light non-aqueous phase liquids (LNAPL), diesel-range hydrocarbons, residual-range hydrocarbons, and gasoline-range hydrocarbons.

RM 5
BP Arco Bulk Terminal (ECSI Site ID 1528) – A TPH plume has discharged to the river. Contaminants include TPH (gasoline-range and diesel-range hydrocarbons) and LNAPL, and the plume extends under the adjacent downstream property.

Exxon Mobil Bulk Terminal (ECSI Site ID 137) – A TPH plume has discharged to the river. Contaminants include gasoline- and diesel-range hydrocarbons.

RM 5.5
Foss Maritime/Brix Marine (ECSI Site ID 2364) – TPH releases from underground storage tanks (USTs) have been identified onsite. Contaminants include gasoline- and diesel-range hydrocarbons.

RM 6
NW Natural/Gasco (ECSI Site ID 84) – Goundwater contamination associated with historical MGP waste is known to be discharging to the river. Contaminants detected in groundwater include PAHs, SVOCs, VOCs (e.g., BTEX), cyanide, sulfide, sulfate and carbon disulfide, ammonia, and metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc). Gasoline-range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbons and total petroleum hydrocarbon fractions are being added to the groundwater monitoring program.

RM 6 and RM 7
Siltronic (ECSI Site ID 183) – A chlorinated VOC plume as well as groundwater plumes associated with historical MGP waste and pesticide plumes from Rhone Poulenc are known to discharge to the river. Contaminants include petroleum-related and chlorinated VOCs (benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,1-dichloroethene, cis-1,2-DCE, trans-1,2-DCE, TCE, and vinyl chloride), PAHs, gasoline-range, diesel-range, and residual-range hydrocarbons, cyanide, metals (arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc), 2,4,5-trichlorophenoxyacetic acid (2,4,5-TP), and 2-(2,4-Dichlorophenoxy)propionic acid (2,4-DP-p).

RM 7
Rhone Poulenc (ECSI Site ID 155) – Known releases of organochlorine insecticides and herbicides, including pentachlorophenol (PCP), 2,4-DP, Bromoxynil, 4(2,4-dichloropenoxy)butyric acid (2,4-DB), 2-methyl-4-chlorophenoxyacetic (MCPA), methylchlorophenoxypropionic acid (MCPP), 4-(4-chloro-2-methylphenoxy)butanoic acid (MCPB), 2,4,5-trichlorophenoxyacetic acid [2,4,5-T], 2,4-dichlorophenoxyacetic acid (2,4-D), DDT, Endrin, Heptachlor, sodium chlorate, sodium arsenate, 2,4,5-TP, aldrin, dieldrin, chlordanes, and 2,4-DP-p have occurred at the site.

Contaminants migrating in groundwater include VOCs, and herbicides. Contaminants infiltrating City Outfall 22B include: SVOCs (2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-methylphenol, pentachlorophenol, and naphthalene), insecticides (aldrin, alpha-chlordane, dieldrin, gamma-chlordane, heptachlor epoxide, hexachlorobenzene, DDD, DDE, and DDT), dioxin/furans (2,3,7,8-tetrachlorodibenzo-p-dioxin [TCDD]) and metals (aluminum, boron, molybdenum, thallium, arsenic, barium, iron, manganese) (ODEQ 2013).

Kinder Morgan Pump Station (ECSI Site ID 2104) – A TPH plume has been identified at the pump station.

Arkema (ECSI Site ID 398) – Contaminants detected in groundwater at the site include, but are not limited to, DDT and its metabolites DDD and DDE (DDx) and VOCs (monochlorobenzene, chloroform, PCE, TCE and benzene), perchlorate and hexavalent chromium.

RM 8
Kinder Morgan Willbridge Bulk Terminal (ECSI Site ID 160) – A TPH plume is not known to be currently discharging to the river. Contaminants include gasoline-range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbons, and arsenic.

Chevron and Unocal Willbridge Bulk Terminal (ECSI Site IDs 25 & 177) – A TPH plume located onsite has discharged to the river. Contaminants include LNAPL, gasoline-range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbons, and metals (arsenic and manganese).

Chevron Asphalt Plant (ECSI Site ID 1281) – Free product consisting of relatively immobile asphalt-related petroleum has been noted on site. Contaminants include TPH (diesel-range and gasoline-range hydrocarbons), arsenic, BTEX and naphthalene.

RM 9
Gunderson (ECSI Site ID 1155) –There is a chlorinated VOC plume (1,1-DCE, 1,1,1-trichloroethane [1,1,1-TCA], PCE, TCE and vinyl chloride) near the downstream end of the Gunderson property. In addition, there is a PAH groundwater plume located between the Equilon (Shell Terminal) pipeline gasoline release and the Equilon dock at Gunderson.

Christensen Oil (ECSI Site ID 2426) – A TPH (Stoddard solvent) plume is located onsite.

Univar (ECSI Site ID 330) – A VOC plume is located onsite. Contaminants include 1,1-dichloroethane (DCA), 1,1-DCE, cis-1,2-DCE, methylene chloride, PCE, toluene, 1,1,1-TCA, TCE, vinyl chloride, and xylenes.

Galvanizers Inc. (ECSI Site ID 1196) – A zinc plume is located at this site.

RM 10
Sulzer Pump (ECSI Site ID 1235) – TPH, PAH, and VOC plumes from UST and waste oil UST releases exist at this site.

RM 11.5
Centennial Mills (ECSI Site ID 5136) – A TPH (diesel-range hydrocarbons) plume is located at this site. The plume is not known to discharge to the river, but may be infiltrating the Tanner Creek sewer line near the river.

1.2.3.5 Riverbanks

Identification of contaminated banks is being managed by DEQ under an MOU with EPA. The following provides a discussion of the known contaminated banks. Additional information on these sites is available in DEQ's ECSI database.

East Side of Willamette River

RM 2
Evraz Oregon Steel Mill (ECSI Site ID 141) – Contaminants present in the riverbank includes PCBs and metals (arsenic, cadmium, chromium, copper, lead, manganese, and zinc).

RM 3.5
Schnitzer Steel Industries (ECSI Site ID 2355) – Results of soils samples collected under the docks along the south shore of the International Slip indicate that contaminants are PCBs and dioxins.

RM 5.5
MarCom South (ECSI Site ID 2350) – Further investigation of the nature and extent of contamination in the bank was conducted in 2012. Contaminants are PAHs and metals (arsenic, cadmium, chromium, copper, zinc).

RM 7
Willamette Cove (ECSI Site ID 2363) - Riverbank contaminants are PCBs, dioxins/furans, metals (lead, mercury, nickel, and copper), and PAHs.

RM 8.5
Swan Island Shipyard (ECSI Site ID 271) – Recent sampling results for OU1 indicate that contaminants include metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs, PCBs, and tributyltin. Contaminants in riverbank soils in OU5 include metals (arsenic, copper, lead, and zinc), PAHs, and PCBs.

West Side of Willamette River

RM 4
Kinder Morgan Linnton Bulk Terminal (ECSI Site ID 1096) – Contaminants are petroleum constituents (BTEXs and PAHs) and metals (arsenic and lead).

RM 6

NW Natural/Gasco (ECSI Site ID 84) – Contamination associated with historical MGP waste are known to be located in the riverbank. Contaminants include PAHs, gasoline-range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbons, cyanide, and metals (zinc).

RM 6 and RM 7
Siltronic (ECSI Site ID 183) – Contamination associated with historical MGP waste is known to be present in the northern portion of the Siltronic riverbank. Riverbank contaminants include PAHs, gasoline-range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbon and cyanide and metals (zinc).

BNSF Railroad Bridge – Contamination associated with pesticide and herbicide releases from Rhone Poulenc and Arkema are known to be present in the riverbank below and adjacent to the BNSF railroad bridge. Riverbank contaminants include dioxin/furans, metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc, insecticides (DDD, DDE, DDT, aldrin, alpha-hexachlorocyclohexane [alpha-BHC], alpha-chlordane, beta-BHC, cis-nonachlor, delta-BHC, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, gamma-BHC, gamma-chlordane heptachlor, heptachlor epoxide, hexachlorobutadiene, methoxychlor, mirex, oxychlordane, and trans-nonachlor), PCBs, SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzoic acid, benzyl alcohol, bis (2-ethylhexyl)phthalate, butylbenzylphthalate, chrysene, bibenzo(a,h)anthracene, dimethylphthalate, di-n-butylphthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene). (AMEC 2011).

RM 7
Arkema (ECSI Site ID 398) –Riverbank contaminants include DDT, dioxin/furans, PCBs, and metals (chromium and lead).

RM 9
Gunderson (ECSI Site ID 1155) –Contaminants include metals (lead, nickel, and zinc), and PCBs.

1.2.4 Contaminant Fate and Transport

Most of the sediment contamination at the Site is associated with known or suspected historical sources and practices. Ongoing sources of contamination include discharging contaminated groundwater plumes, erodible riverbank soils, stormwater, upstream surface water, and sediment bedload. The distribution of contaminants in sediments in several nearshore areas appears to reflect more significant historical lateral inputs. Persistent contaminants (particularly PCBs and dioxin/furans) from sediments and surface water bioaccumulate in progressively higher trophic levels within the food chain.

Internal contaminant fate and transport processes are those processes that affect the fate, transport and redistribution of contaminants within the Study Area. The major internal fate and transport processes are:

- Erosion from the sediment bed
- Deposition to the sediment bed
- Dissolved flux from the sediment bed (porewater exchange)
- Groundwater advection
- Degradation (for some contaminants)
- Volatilization
- Downstream transport of either particulate-bound or dissolved phase contaminants

These processes interact to create complex patterns of contaminant redistribution that vary over space, time, and by contaminant. Empirical estimates of contaminant loading associated with internal and external contaminant sources were developed during the RI. External sources include upstream loading (via surface water and sediment bedload), "lateral" external loading such as stormwater runoff permitted discharges (point-source, non-stormwater), upland groundwater (contaminant plume transport to river), atmospheric deposition (to the river surface), direct upland soil and riverbank erosion, otherwise uncontaminated groundwater advection through contaminated subsurface sediments (chemical partitioning from subsurface sediment to porewater and advection to the surface sediment interval), and overwater releases. Internal sources include surface sediment loading to the surface water via sediment erosion (resuspension) and sediment porewater exchange (chemical partitioning from surface sediment to porewater and advection to surface water), as well as sinks. **Figures 1.2-22a** through **1.2-22c** provides a visual summary of currently known or suspected contaminant source loads within and exiting from the Site for three representative contaminants: total PCBs, benzo(a)pyrene, and DDE.

Elevated contaminant concentrations in the Study Area are typically associated with areas near currently known or likely historical and/or existing sources. Although the highest sediment [5]contaminant concentrations are generally found in nearshore areas, higher concentrations are also found in the higher-energy portion of the channel in the middle of the Study Area (RM 5 to 7). This may reflect past or current dispersal of material away from nearshore source areas. Throughout the Study Area, contaminant concentrations are generally higher in subsurface sediments than in surface sediments, indicating both higher historical contaminant inputs and improving sediment quality

[5]

over time. Localized exceptions to the pattern of higher subsurface sediment concentrations exist in a few areas for some contaminants, likely reflecting more recent releases and/or disturbances of bedded sediments. Also, the depth of subsurface contamination is generally greater in nearshore areas as compared to the navigation channel.

Areas with elevated contaminant concentrations in surface sediments generally correspond to areas of elevated subsurface sediment contaminant concentrations, particularly in nearshore areas. Areas where only surface or subsurface sediments exhibited elevated concentrations of contaminants point to spatially and temporally variable inputs and sources, or to different influences from sediment transport mechanisms. The PCB distributions in areas of elevated PCB concentrations are generally distinct from those in surrounding areas of lower PCB concentrations. Within areas of elevated PCB concentrations, the PCB patterns in surface and subsurface sediment, sediment traps, and in the particulate portion of the surface water samples are often similar. A similar pattern and similar composition across media was observed to a lesser degree for PAHs, but was less apparent for dioxins/furans or DDx compounds.

Most areas of elevated contaminant concentration in bedded sediment are located in relatively stable nearshore areas, and large-scale downstream migration/dispersal of concentrated contaminants from these areas is not indicated by the bedded sediment data. Much larger historical direct discharges from upland and overwater sources, rather than reworking of bedded sediments, are believed to have produced some of the observed patterns (e.g., elevated levels in subsurface sediments downstream of the source areas). Limited ongoing downstream dispersal of contaminants in sediments is suggested based on bedded sediment concentration gradients downstream of areas with elevated sediment concentrations.

Patterns of contamination in bedded surface sediment indicate some redistribution of contaminants over time from past source areas, but this is limited by burial of much of the source area contamination as indicated by higher subsurface sediment concentrations in these areas. Periodic erosion may temporarily expose buried contamination.

Based on results of surface water data collected during the RI, resuspension and/or dissolved phase flux from the sediment bed are contributing to contaminant concentrations in surface water, particularly in quiescent areas where surface water mixing and dilution is minimal. Loading estimates presented in **Figures 1.2-22a** through **1.2-22c** are consistent with this concept, indicating the mass flux of contaminants exiting the downstream end of the Study Area in surface water, either directly to the Columbia River or via Multnomah Channel, is greater than the flux entering the Study Area.

Contaminant concentrations in stormwater entering the Study Area are generally greater than concentrations associated with upstream surface water. However, from a loading perspective, lateral contaminated loads associated with upland sources are comparable to upstream loads for certain contaminants.

Groundwater plume discharge to surface water has been observed in several areas. Dissolved phase flux from surface sediments to the water column has been inferred from RI data.

Finally, empirical tissue contaminant data and food web modeling indicate that persistent contaminants (particularly PCBs and dioxin/furans) in sediments and surface water can bioaccumulate in aquatic species tissue.

The CSM integrates the information gathered to date to provide a coherent hypothesis of the Site fate and transport. **Figure 1.2-23** provides a simplified visual summary of this hypothesis, including contaminant interactions with human and ecological receptors.

1.2.5 -Baseline Risk Assessment

This section presents a summary of the results of the baseline human health and ecological risk assessments (BHHRA and BERA). These assessments are presented in Appendix F and Appendix G of the RI report.

1.2.5.1 Baseline Human Health Risk Assessment

The BHHRA presents an analysis of the potential for effects associated with both current and potential future human exposures at Portland Harbor. Potential exposure to contaminants found in environmental media and biota was evaluated for various occupational and recreational uses of the river, as well as recreational, subsistence, and traditional and ceremonial tribal consumption of fish caught within the Portland Harbor site. Additionally, because of the persistent and bioaccumulative nature of many of the contaminants found in sediment, infant consumption of human breast milk was also quantitatively evaluated.

Consistent with EPA policy, the BHHRA evaluated a reasonable maximum exposure (RME), which is defined as the maximum exposure that is reasonably expected to occur. In addition, estimates of central tendency (CT), which are intended to represent average exposures, were also evaluated. **Figure 1.2-24** presents the CSM for the BHHRA and **Table 1.2-2** provides a list of chemicals potentially posing unacceptable risks for human health.

The major findings of the BHHRA are:

- Estimated cancer risks resulting from the consumption of fish or shellfish are generally orders of magnitude higher than risk resulting from direct contact with sediment and surface water. Risks and noncancer hazards from fish and shellfish consumption exceed the EPA point of departure for cancer risk of 1 x 10^{-4} and target hazard index (HI) of 1 when evaluated on a harbor-wide basis, and when evaluated on the smaller spatial scale by river mile.

- Consumption of resident fish species consistently results in the greatest risk estimates. Evaluated harbor-wide, the estimated RME cancer risks are 4×10^{-3} and 1×10^{-2} for recreational and subsistence fishers, respectively.

- Evaluated on a river mile scale, it is only at RM 5 that RME risk estimates from consumption of resident fish is less than 1×10^{-4}.

- Noncancer hazard estimates for consumption of resident fish species are greater than 1 at all river miles. Based on a harbor-wide evaluation of noncancer risk, the estimated RME HI is 300 and 1,000 for recreational and subsistence fisher, respectively. The highest hazard estimates for recreational fishers are at RM 4, RM 7, RM 11, and in Swan Island Lagoon.

  The highest noncancer hazards are associated with nursing infants of mothers who consume resident fish from Portland Harbor for 20 years prior to giving birth. When fish consumption is evaluated on a harbor-wide basis, the estimated RME HI is 4,000 and 10,000 for breastfed infants of recreational and subsistence fishers, respectively. Evaluated on a harbor-wide scale, the estimated RME HI for tribal consumers of migratory and resident fish is 600 assuming fillet-only consumption, and 800 assuming whole-body consumption. The corresponding HI estimates for nursing infants of mothers who consume resident fish from Portland Harbor for 20 years prior to giving birth, are 8,000 and 9,000 respectively, assuming maternal consumption of fillet or whole-body fish.

- PCBs are the primary contributor to risk from fish consumption harbor-wide. When evaluated on a river mile scale, dioxins/furans are a secondary contributor to the overall risk and hazard estimates. PCBs are the primary contributors to the noncancer hazard to nursing infants, primarily because of the bioaccumulative properties of PCBs and the susceptibility of infants to the developmental effects associated with exposure to PCBs.

- The greatest source of uncertainty in the risk and hazard estimates includes the lack of good site-specific information about consumption of resident fish from Portland Harbor. Because tribal fish consumption practices were evaluated assuming a combined diet consisting of both resident and migratory fish, it is not clear to what degree contamination in Portland Harbor contributes to those estimated risks. In addition, it is important to remember that the noncancer hazard estimates presented in the BHHRA are not predictions of specific disease, and the cancer estimates represent upper-bound values, and the EPA is reasonably confident that the actual cancer risks will not exceed the estimated risks presented in the BHHRA.

1.2.5.2 Baseline Ecological Risk Assessment

The BERA presents an evaluation of risks to aquatic and aquatic-dependent species within the Study Area in the absence of any actions to control or mitigate contaminant releases. The overall process used for the BERA was based on the guidance provided in the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final* (EPA 1997c) and followed the approach documented in numerous interim deliverables as well as discussions, directives, and agreements with the LWG, EPA and its federal, state, and tribal partners. **Figure 1.2-25** presents the CSM for the BERA and **Table 1.2-3** provides a list of contaminants of potential concern (COPCs) posing potentially unacceptable ecological risks within the Portland Harbor Study Area. A list of chemicals identified as most likely to be contaminants of ecological significance is provided in **Table 1.2-4**.

The following presents the primary conclusions of the BERA.

- In total, 93 contaminants (as individual contaminants, sums, or totals)[6] with HQ $\geq$ 1.0 pose potentially unacceptable ecological risk. Differences in the specific toxicity reference values (TRVs) used in different lines of evidence (LOEs) for total PCBs (e.g., total PCBs versus specific Aroclor mixtures), total DDx, and total PAHs, all of which describe individual contaminants or a group of multiple but related individual chemical compounds, can result in different counts of the number of contaminants posing potentially unacceptable risk. The list of contaminants posing potentially unacceptable risks can be condensed if individual PCB, DDx and PAH compounds or groups are condensed into three comprehensive groups: total PCBs, total DDx, and total PAHs. Doing so reduces the number of contaminants with HQ $\geq$ 1.0 posing potentially unacceptable risks to 66.

- Risks to benthic invertebrates are clustered in 17 benthic areas of concern (AOCs).

- Sediment and TZW samples with the highest HQs for many contaminants also tend to be clustered in areas with the greatest benthic invertebrate toxicity.

- The COPCs in sediment that are most commonly spatially associated with locations of potentially unacceptable risk to the benthic community or populations are PAHs and DDx compounds.

- Not all COPCs posing potentially unacceptable risk have equal ecological significance. The most ecologically significant COPCs (i.e., contaminants of

[6] The five chemicals or chemical groups with concentrations that exceeded only the sediment probable effects concentration (PEC) and/or probable effects level (PEL) (i.e., chemicals that were not identified as COPCs for other benthic invertebrate LOEs: Aroclor 1254, chlordane [cis and trans], gamma- hexachlorocyclohexane [HCH] [Lindane], heptachlor epoxide, and total chlordane), ammonia and sulfide (which are conventional parameters), and residual-range hydrocarbons that had concentrations that exceeded only the total petroleum hydrocarbons [TPH] SQGs) are not included in this count.

primary ecological significance) are PCBs, PAHs, dioxins and furans (as toxic equivalent [TEQ]), and DDT and its metabolites.

- The list of ecologically significant COPCs is not intended to suggest that other contaminants in the Study Area do not also present potentially unacceptable risk.

- The contaminants identified as posing potentially unacceptable risk in the largest numbers of LOEs are (in decreasing frequency of occurrence) total PCBs, copper, total DDx, lead, tributyltin (TBT), zinc, total TEQ, PCB TEQ, benzo(a)pyrene, cadmium, 4,4′-DDT, dioxin/furan TEQ, bis(2-ethylhexyl) phthalate, naphthalene, and benzo(a)anthracene. The remaining 78 contaminants posing potentially unacceptable risk were identified as posing potentially unacceptable risk by three or fewer LOEs.

- Of the three groups of contaminants (i.e., total PAHs, total PCBs, total DDx) with the greatest areal extent of HQs ≥ 1.0 in the Study Area, PAH and DDx risks are largely limited to benthic invertebrates and other sediment-associated receptors. PCBs tend to pose their largest ecological risks to mammals and birds.

- The combined toxicity of dioxins/furans and dioxin-like PCBs, expressed as total TEQ, poses the potential risk of reduced reproductive success in mink, river otter, spotted sandpiper, bald eagle, and osprey. The PCB TEQ fraction of the total TEQ is responsible for the majority of total TEQ exposure, but the total dioxin/furan TEQ fraction also exceeds its TRV in some locations of the Study Area.

1.3 FS DATABASE DESCRIPTION

This section describes the FS database that contains the sediment data used in the alternatives development and evaluations in this FS. The source of the sediment data within the FS database is the Site Characterization and Risk Assessment (SCRA) database used for evaluations in the RI Report (RI citation). However, the SCRA database did not use summing rules that were consistent with those used in the baseline risk assessment (BRA). To allow for evaluations of risk reduction based on various alternatives presented in this report, it was necessary to ensure that the data were treated in a manner consistent with the BRA. Data selection, evaluation, summation rules, and other rules and procedures for the FS database are described in Appendix A. The FS database only includes sediment data and does not contain porewater, surface water, TZW, or biota/tissue data; those data are retained in the SCRA database although they may be used for analysis in this FS.

For the RI and FS, a date of May 1, 1997, was used to define the initiation of the sediment dataset, which follows the last major flood of the lower Willamette River in the winter of 1996. The SCRA database includes data collected through July 19, 2010. However, the following additional sediment data was added to the FS database:

- Additional updates to the SCRA database posted to the LWG's portal through February 4, 2011

- Gasco Engineering Evaluation/Cost Analysis (EE/CA) data as provided by Anchor QEA in 2013 and meeting the FS sediment database protocols described in Appendix A

- Arkema EE/CA data as provided by Integral in May 2014 and meeting the FS sediment database protocols described in Appendix A

As noted in Section 1.2.2.3, the RM11E Group entered into an AOC to collect additional data (to include sediment, riverbank soil, porewater, and groundwater data) in support of preliminary remedial design activities. While these sediment data were not included within the FS database due to timing, all the data will be available in the Administrative Record for use during remedial design.

The SCRA database or the FS database may be used for some depictions or evaluations in this FS. Unless otherwise noted, the FS database was used for evaluations of sediment in this report.

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3-00026

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3-00028

Complete FS Task	Subtask	TCT Review & Resolution Start	TCT Review & Resolution End	LWG Review & Resolution Start	LWG Review & Resolution End	Provide LWG/TCT/CAG/HQ Proposed final modifications
Section 1	**Introduction**	6/2/2014	7/2/2014	7/8/2014	8/29/2014	1/9/2015
	Purpose & Organization					
	Site History					
	Nature & Extent of Contamination					
	Contaminant Fate & Xport					
	Baseline Risk Assessment					
Appendix A	FS Database Description					
Section 2	**Identification & Screening of Technologies**	8/4/2014	1/14/2015	2/6/2015	3/23/2015	4/6/2015
	Introduction	**Assumptions:**	* EPA is currently modifying the section based on TCT comments			
	RAOs/PRGs		* Need to resolve background dispute			
	General Response Actions		* Need to resolve dioxin/furan PRGs			
	ID & Screen Technologies					
Appendix B	**Derrivation of risk-based PRGs**			* LWG has 30 days to review and identify issues and 15 days to resolve issues		
Appendix C	**Description of Food Web Model**					* EPA has 2 weeks to incoroporate issue resolutions into docum
Section 3	**Development & Screening of Alternatives**	3/4/2015	5/4/2015	5/18/2015	7/2/2015	7/16/2015
	Focussed COCs	* TCT has 30 days to review and draft comments				
	RALs	* 14 days for comment resolution				
	PTW/source material	* 14 days for EPA to make revisions				
	Development & Screening of Alternatives					
				* LWG has 30 days to review and identify issues and 15 days to resolve issues		
						* EPA has 2 weeks to incoroporate issue resolutions into docum
Section 4	**Detailed Analysis of Alternatives**	5/3/2015	7/2/2015	7/16/2015	8/30/2015	9/13/2015
	Alternative Definition					
	Individual Analysis of Alternatives					
	Comparative Analysis Presentation	* TCT has 30 days to review and draft comments				
References		* 14 days for comment resolution				
		* 14 days for EPA to make revisions				
		* EPA provides initial Remedy Concept				
				* LWG has 30 days to review and identify issues and 15 da		
					* EPA provides Remedy Concept	
						* EPA has 2 weeks to incoroporate issue resolutions into docum
Executive Summary				7/16/2015	8/30/2015	9/13/2015
			* Exectutive Summary can be completed with Section 4			

Tasks to complete ROD	**Duration (days)**	**Start**	**End**	**Assumptions**
Info to NRRB/CSTAG		10/13/2015		Gives CAG 30 days to review Section 4 and draft NRRB/CSTAG comments
				Per NRRB guidance, documentation to be provided 30 days prior to NRRB revie
NRRB/CSTAG	30	11/12/2015		NRRB/CSTAG may be 2 days

Green shading indicates dates that have already occurred.

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Complete FS Task	Subtask	LWG Review & Resolution Start	LWG Review & Resolution End	Provide LWG/TCT/CAG/HQ Proposed final modifications
Section 1	**Introduction**	7/8/2014	8/29/2014	1/9/2015
	Purpose & Organization			
	Site History			
	Nature & Extent of Contamination			
	Contaminant Fate & Xport			
	Baseline Risk Assessment			
Appendix A	FS Database Description			
Section 2	**Identification & Screening of Technologies**	2/6/2015	3/23/2015	4/6/2015
	Introduction			
	RAOs/PRGs			
	General Response Actions			
	ID & Screen Technologies			
Appendix B	**Derrivation of risk-based PRGs**	* LWG has 30 days to review and identify issues and 15 days to resolve issues		
Appendix C	**Description of Food Web Model**			* EPA has 2 weeks to incoroporate issue resolutions into document
Section 3	**Development & Screening of Alternatives**	5/18/2015	7/2/2015	7/16/2015
	Focussed COCs			
	RALs			
	PTW/source material			
	Development & Screening of Alternatives			
		* LWG has 30 days to review and identify issues and 15 days to resolve issues		
				* EPA has 2 weeks to incoroporate issue resolutions into document
Section 4	**Detailed Analysis of Alternatives**	7/16/2015	8/30/2015	9/13/2015
	Alternative Definition			
	Individual Analysis of Alternatives			
	Comparative Analysis Presentation			
References				
		* LWG has 30 days to review and identify issues and 15 days to resolve issues		
				* EPA has 2 weeks to incoroporate issue resolutions into document
Executive Summary		7/16/2015	8/30/2015	9/13/2015
			* Exectutive Summary can be completed with Section 4	

Tasks to complete ROD	Duration (days)	Start	End	Assumptions
Info to NRRB/CSTAG		10/13/2015		Gives CAG 30 days to review Section 4 and draft NRRB/CSTAG comments
				Per NRRB guidance, documentation to be provided 30 days prior to NRRB review
NRRB/CSTAG	30	11/12/2015		NRRB/CSTAG may be 2 days

Green shading indicates dates that have already occurred.

w date

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Portland_Harbor_SMAs.gdb/a0...	5,152	1/16/2015 3:02 PM
Portland_Harbor_SMAs.gdb/a0...	4,118	1/16/2015 3:02 PM
Portland_Harbor_SMAs.gdb/a0...	2,055	1/16/2015 3:00 PM
Portland_Harbor_SMAs.gdb/a0...	5,152	1/16/2015 3:00 PM
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Portland_Harbor_SMAs.gdb/tim...	400	1/16/2015 3:35 PM

Comment

To: Woolford, James[Woolford.James@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Zhen, Davis[Zhen.Davis@epa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; Cora, Lori[Cora.Lori@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Christopher, Anne[Christopher.Anne@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Charters, David[Charters.DavidW@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Gartner, Lois[Gartner.Lois@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]; Rigger, Don[Rigger.Don@epa.gov]
Cc: Breen, Barry[Breen.Barry@epa.gov]; Stanislaus, Mathy[Stanislaus.Mathy@epa.gov]
From: Grandinetti, Cami
Sent: Fri 9/4/2015 6:46:50 PM
Subject: Region 10 Portland Harbor Briefing materials for Administrator briefing 9/8/15
2015 9-8 Briefing Memo - Portland Harbor.docx
Administrator Briefing 9-08-15.pptx

Attached please find the briefing materials for our briefing with the Administrator on Portland Harbor next Tuesday, September 8 at 1:30 pm pacific, 4:30 pm eastern.

These materials have been sent directly to the Administrator's office under separate email.

Thank you!

Cami Grandinetti

Program Manager, Remedial Cleanup Program

USEPA

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From: Robinson, Deborah
Sent: Thur 4/30/2015 7:17:52 PM
Subject: Action by 5/6 - Please send agenda notes - Portland Harbor TCT Agenda for 5/13/2015
TCT Meeting Agenda_5-13-15.docx

Dear all,

Attached is the skeleton agenda for the 5/13/15 TCT Meeting. This meeting is scheduled for 9:30 am – noon.

Please send me information updates by COB 5/6/15, so I can include them in the agenda for the meeting. Please also let me know if you have in-depth discussion topics.

If I missed someone for the recipient list, please forward this message and let me know.

Thank you, Debbie

======================================

From the Desk of:

Deborah Robinson

U.S.Environmental Protection Agency

1200 Sixth Avenue, Suite 900

Seattle, Washington 98101

(206) 553-4961

robinson.deborah@epa.gov

TCT Meeting Agenda
May 13, 2015

Where: Portland EPA Operations Office, Conference Room
When: 09:30 am to noon
Call-In Personal Privacy / Ex. 6

Project Updates

Community Involvement Update
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

Early Actions
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

RI Report
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

FS Report
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

DEQ Upland Source Control
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

Upcoming meetings
- 5/13 1:00-3:30 EPA/DEQ Meeting
- 5/13 6:00-8:00 CAG
- 5/27 9:00-11:00 PH TCT meeting (conf. call)

Next TCT Meeting:

May 27, 2015; 9:00 to 11:00 by conference call

NOTE: TCT members strongly encouraged to provide suggestions for In-Depth Discussion Topics.

To: Koch, Kristine[Koch.Kristine@epa.gov]; Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Audie Huber (audiehuber@ctuir.com)[audiehuber@ctuir.com]; Blischke, Eric[blischkee@cdmsmith.com]; Brian Cunninghame (cunninghame@gorge.net)[cunninghame@gorge.net]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; Coffey, Scott[CoffeySE@cdmsmith.com]; Conley, Alanna[conley.alanna@epa.gov]; Erin Madden (erin.madden@gmail.com)[erin.madden@gmail.com]; Fuentes, Rene[fuentes.rene@epa.gov]; Gabriel Moses **Personal Privacy / Ex. 6** Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Hagerman, Paul[HagermanPR@cdmsmith.com]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; JD Williams (jd@williamsjohnsonlaw.com)[jd@williamsjohnsonlaw.com]; Jeanette Mullin (mullinjm@cdmsmith.com)[mullinjm@cdmsmith.com]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; Julie Weis (jweis@hk-law.com)[jweis@hk-law.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Kristin Callahan (kristin@ridolfi.com)[kristin@ridolfi.com]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Morrison, Kay[morrison.kay@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]; rdelvecchio@indecon.com DelVecchio[RDelVecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Shephard, Burt[Shephard.Burt@epa.gov]; Todd King (KingTW@cdmsmith.com)[KingTW@cdmsmith.com]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; Tom Gainer (gainer.tom@deq.state.or.us)[gainer.tom@deq.state.or.us]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Charters, David[Charters.DavidW@epa.gov]
From: Robinson, Deborah
Sent: Wed 4/8/2015 12:36:12 AM
Subject: ACTUAL Portland Harbor TCT Agenda for 4/8/2015
TCT Meeting Agenda_4-8-15.docx

Dear TCT,

With many apologies, I am attaching the actual agenda for the Portland Harbor TCT meeting tomorrow, 4/8.

I inadvertently used the incorrect attachment in my original email.

Thank you to Tom Gainer for noticing and letting me know right away.

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Attached is the agenda for the 4/8/15 TCT Meeting. Please let Kristine Koch know if you have additional topics.

This month, we collected update information and included it in the agenda. If you have questions or comments about any of the updates, please feel free to raise them at the meeting. We hope this approach will streamline the meetings and/or allow more time for any necessary in-depth conversation.

Thank you, Debbie

=====================================

From the Desk of:

Deborah Robinson

U.S.Environmental Protection Agency

1200 Sixth Avenue, Suite 900

Seattle, Washington 98101

(206) 553-4961

robinson.deborah@epa.gov

TCT Meeting Agenda
April 8, 2015

Where: Portland EPA Operations Office, Conference Room
When: 09:30 am to noon
Call-In Personal Privacy / Ex. 6

Project Updates

Community Involvement Update
- **CAG meeting, April 8, 6pm,** Technology Talk: Dredging and Best management controls for haul trucks
- **Introduction to Superfund/Portland Harbor:** A Public Awareness Workshop, May 21st 6:30-8:30pm with Oregon Chapter of the Sierra Club, 1821 S.E. Ankeny
- Upon request and based on interest, I can verbally recap activities conducted in prior month during meeting.

Early Actions
- Recap of activities conducted in prior month
- Schedule of activities in upcoming month

RI Report
- EPA is working on finalizing the Executive Summary
- LWG calculations of background are due 4/25/15.
- Week of April 13, 2015, EPA will direct LWG to produce Draft Final RI.
- LWG will have 30 days to produce the draft final document.

FS Report
- LWG provided comments for FS Section 2 on 3/25 and 3/26.
- EPA is providing written responses to the comments.
- A meeting is set for April 10 to discuss EPA responses.

DEQ Upland Source Control
- Matt is the new Tom. Tom Gainer is retiring from DEQ on April 9, 2015. After that date Matt McClincy will be DEQ's TCT point of contact for both the in-water and upland source control work. Matt's role as the in-water point of contact is interim, and DEQ intends to make a permanent assignment in the near future.
- DEQ Source Control Video. DEQ is completing work with a video contractor to feature source control efforts at three sites and some stakeholder perspectives. These will be integrated in DEQ's outreach presentation program, currently being developed as a multi-media platform, for viewing by the public and presentation to interested groups. The outreach video will be presented to the DEQ Environmental Quality Commission on April 16, 2015 and public presentations will follow shortly thereafter.
- St. John's Neighborhood Assoc. Meeting Monday, April 13th at 7pm at the St. Johns Community Center (8427 N Central). Willamette Cove – Overview of the planned upland removal.

Upcoming meetings
- 4/8 1:00-3:30 EPA/DEQ Meeting
- 4/8 6:00-8:00 CAG - Dredging
- 4/10 9:30-12:30 FS Section 2 comment/response
- 4/10 1:30-4 Bioaccumulation modeling report
- 4/14 10:30-12 PH Manager Meeting
- 4/21 1:30-3 PH Execs Meeting
- 4/21 3:30-4:30 PH MOU Partners Meeting

- 4/21 5:00-6:00 PH Community Meeting
- 4/22 9:00-12:00 PH TCT meeting (conf. call)

Next TCT Meeting:

April 22, 2015; 9:00 to 11:00 by conference call

NOTE: TCT members strongly encouraged to provide suggestions for In-Depth Discussion Topics.

To: Alex Liverman (liverman.alex@deq.state.or.us)[liverman.alex@deq.state.or.us]; Allen, Elizabeth[allen.elizabeth@epa.gov]; Audie Huber (audiehuber@ctuir.com)[audiehuber@ctuir.com]; Blischke, Eric[blischkee@cdmsmith.com]; Brian Cunninghame (cunninghame@gorge.net)[cunninghame@gorge.net]; callie@ridolfi.com[callie@ridolfi.com]; Christopher, Anne[Christopher.Anne@epa.gov]; Coffey, Scott[CoffeySE@cdmsmith.com]; Conley, Alanna[conley.alanna@epa.gov]; Erin Madden (erin.madden@gmail.com)[erin.madden@gmail.com]; Fuentes, Rene[fuentes.rene@epa.gov]; Gabriel Moses **Personal Privacy / Ex. 6** Gail Fricano (gfricano@indecon.com)[gfricano@indecon.com]; Genevieve Angle (Genevieve.Angle@noaa.gov)[Genevieve.Angle@noaa.gov]; Hagerman, Paul[HagermanPR@cdmsmith.com]; Holly Partridge (Holly.Partridge@grandronde.org)[Holly.Partridge@grandronde.org]; JD Williams (jd@williamsjohnsonlaw.com)[jd@williamsjohnsonlaw.com]; Jeanette Mullin (mullinjm@cdmsmith.com)[mullinjm@cdmsmith.com]; peterson.Jennifer@deq.state.or.us[peterson.Jennifer@deq.state.or.us]; Jeremy_Buck@fws.gov[Jeremy_Buck@fws.gov]; Julie Weis (jweis@hk-law.com)[jweis@hk-law.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Kristin Callahan (kristin@ridolfi.com)[kristin@ridolfi.com]; Matt McClincy (mcclincy.matt@deq.state.or.us)[mcclincy.matt@deq.state.or.us]; Michael.karnosh@grandronde.org[Michael.karnosh@grandronde.org]; poulsen.mike@deq.state.or.us[poulsen.mike@deq.state.or.us]; Morrison, Kay[morrison.kay@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]; rdelvecchio@indecon.com DelVecchio[RDelVecchio@indecon.com]; Rita Cabral (rcabral@indecon.com)[rcabral@indecon.com]; Robert.Neely@noaa.gov[Robert.Neely@noaa.gov]; Robinson, Deborah[Robinson.Deborah@epa.gov]; rose@yakamafish-nsn.gov[rose@yakamafish-nsn.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Todd King (KingTW@cdmsmith.com)[KingTW@cdmsmith.com]; tomd@ctsi.nsn.us[tomd@ctsi.nsn.us]; Tom Gainer (gainer.tom@deq.state.or.us)[gainer.tom@deq.state.or.us]
Cc: Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Legare, Amy[Legare.Amy@epa.gov]
From: Koch, Kristine
Sent: Mon 3/16/2015 2:35:50 PM
Subject: Portland Harbor - Meeting notes from 3/11 TCT meeting
TCT Meeting Notes_Summary_2015-03-11_Rev1.docx

All – here are the meeting notes from the last TCT meeting. Let me know if you have any corrections.

Thanks,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
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TCT Meeting Notes

Oregon Operations Office, Portland
March 11, 2015

Participants:

Kristine Koch, EPA
Sean Sheldrake, EPA
Elizabeth Allen, EPA
Rich Muza, EPA
Rene Fuentes, EPA
Debbie Robinson, EPA
Anne Christopher, EPA
Alanna Conley, EPA
Deb Yamamoto, EPA
Silvina Fonseca, EPA
Cami Grandinetti, EPA
Burt Shephard, EPA
David Charters, EPA
Amy Legare, EPA
Kristin Callahan, Ridolfi
Kevin Parrett, DEQ
Dan Hafley, DEQ
Rita Cabral, Five Tribes
Matt McClincy, DEQ
Tom Gainer, DEQ
Gail Fricano, Five Tribes
Erin Madden, Nez Perce
Genevieve Angle, NMFS
Scott Coffey, CDM Smith
Jeanette Mullin, CDM Smith

The meeting began at 9:40 am.

Community Involvement Update

Clean Water Summit: Sean Sheldrake and Alanna Conley participated in the Clean Water Summit.

Portland Harbor Community Coalition: A meeting will be held tomorrow with the Portland Harbor Community Coalition where the EPA will provide an update on Portland Harbor. EPA provided general information on Portland Harbor and the Superfund Program for an article in their newsletter.

EPA has been in contact with Karen Bishop, OHA, to discuss opportunities to bring the coalition group together and discuss Portland Harbor.

Early Actions Update

Arkema:
Sean Sheldrake is working to schedule a meeting to discuss the main issues in the comment letter with regards to the proposed sampling plan. Some of the issues include toxicity testing and logging of cores containing non-aqueous phase liquid (NAPL). The deadline is July 31st for approval/disapproval of the work plan. Sean will invite Dave Charters to provide input on the ecological toxicity issue. Note: a meeting is being scheduled at the site on April 7th.

There were no other updates for the other Early Actions sites.

Remedial Investigation (RI) Report Update

Section 10:
The Lower Willamette Group (LWG) wants additional context added for the breast milk summary section. EPA has replied "no" because it is not in other sections. LWG has elevated this to senior management.

Executive Summary:
LWG submitted additional comments, but did not ask for an extension for negotiations. EPA found duplicative comments in their submittal, and odd arguments against their own document. LWG also submitted additional comments that they do not agree with some of EPA's statements. Both EPA and LWG agree that additional information was needed. For example, nature and extent of contaminants.

Section 7 Dispute:
No dispute decision has been released yet, but the decision should be coming soon. EPA will get the Executive Summary completed, so when the Section 10 and Section 7 issues are finalized, the RI Report can be finalized, possibly by April 15th.

Feasibility Study (FS) Report Update

Section 1:
Additional comments were recently received from LWG. These additional comments were outside the review cycle process. EPA's position is that this section is complete and no further modifications will be made.

Section 2:
EPA submitted the revised Section 2 to TCT and LWG on Monday, February 23, 2015. LWG has until March 25th to comment, then negotiate until April 9th. EPA has not received any requests for discussions on this section from LWG.

FS Section 3:
Work continues on technical aspects. **Correction Note: EPA stated during the meeting that FS Section 3 would be submitted for review by mid-April. FS Section 3 is actually scheduled to be released for review by mid-May.**

DEQ Upland Source Control Update

Proposed Source Control Decisions: DEQ looking to receive feedback on two proposed source control decisions: 1) Oregon Beverage Site, and 2) Rhone Poulenc historical drainage ditch. Matt McClincy pointed out that the review period does not have a hard deadline. EPA has requested more time and DEQ is open to receiving comments.

Upland Source Control Summary Report: LWG has asked DEQ to provide information on the source control summary report. The meeting has not been scheduled yet. DEQ is open to scheduling a meeting on this with the Partners.

Chuck Harmon, DEQ Manager managing the Premier Edible Oils site, is retiring.

Meetings

- March 12, 2015: LWG meeting RE: dioxin/furan congener mapping and moving forward with final RALs in general

Update on EPA Roles and Responsibilities

EPA provided a document to the TCT detailing EPA staff's roles and responsibilities for Portland Harbor.

TCT Question: If a question presents itself about a specific topic, should it be directed to the EPA lead responsible for that topic? EPA Response: Yes.

DEQ Oversight of In-Water Work

Kevin Parrett, DEQ, presented DEQ's proposal to provide oversight of in-water work at a few high priority sites to the TCT. DEQ approached EPA with this proposal last summer. DEQ will use state authority to provide oversight for pre-remedial design at two priority sites: Willamette Cove and River Mile 11 East (RM11E). EPA clarified that Sean Sheldrake will become the primary point of contact for source control issues for both Willamette Cove (formerly managed by Rich Muza) and 11E.

DEQ wanted TCT input before rolling out formally to the two parties. DEQ plans to enter into a Consent Order with the parties for pre-remedial design activities and get it close to a final design to expedite the cleanup process.

The anticipated steps are as follows: 1) prepare a basis of design document; 2) get 30% design by 3rd quarter of 2016, 3) get 60% or 90% design by end of 1st quarter of 2017. DEQ would provide the documents to the TCT members for review. DEQ expects the parties to enter into funding agreements to fund the TCT group for their reviews.

Next Steps: DEQ will roll out to the Community Advisory Group (CAG) next month on April 8th, and DEQ will provide a heads up to elected officials and LWG representatives. DEQ will report back to the Memorandum of Understanding (MOU) partners and obtain concerns and how to proceed. DEQ anticipates negotiating Consent Orders in the May/July timeframe and negotiating funding agreements.

Dan Hafley will be the DEQ Project Manager for Willamette Cove. DEQ still determining who will be the Project Manager for RM11E as the individual slotted for this position is retiring. DEQ will only move forward at these high priority sites if there is a high probability of success.

The bi-monthly TCT meetings will be used to provide status updates on DEQ's progress on the in-water work oversight task.

FS Section 2 – Discussion of EPA's Modifications

EPA sent out FS Section 2 on February 23, 2015 after incorporating comments. EPA received questions from TCT members and provided this opportunity to discuss their concerns and answer questions.

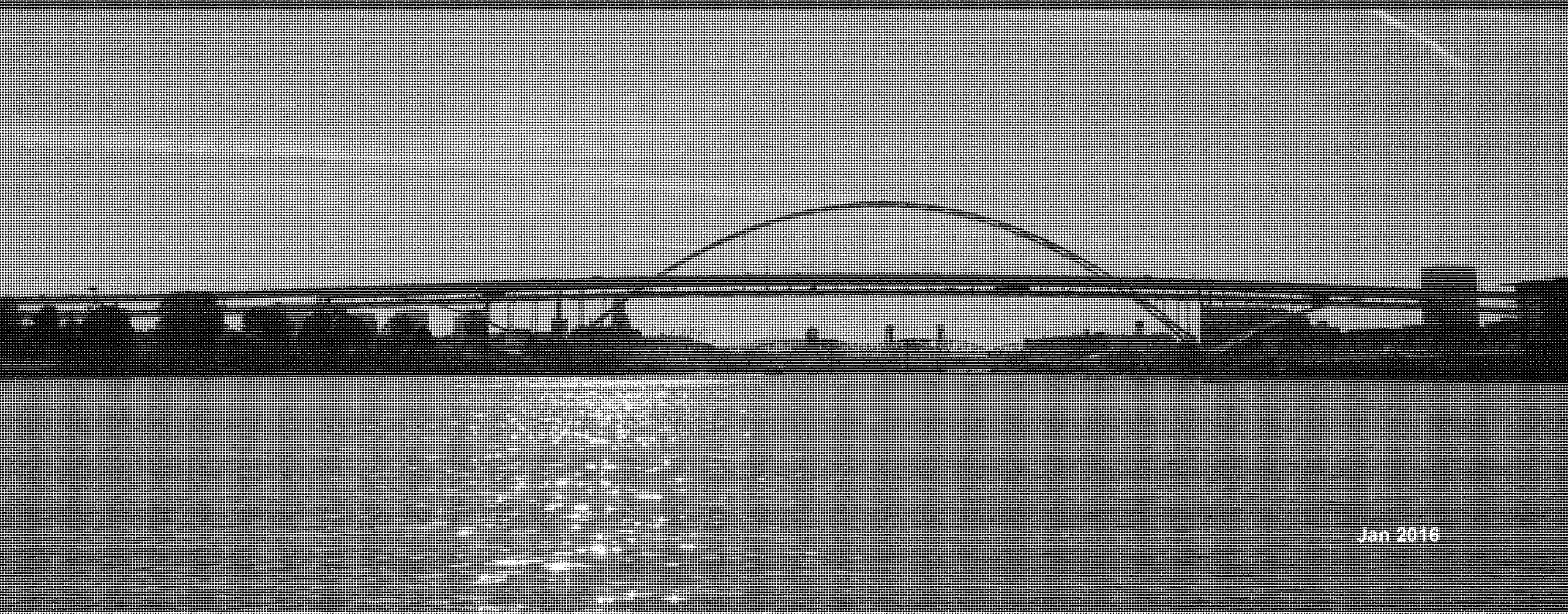
FS Section 3 Briefing

EPA presented a re-cap of the FS Section 3 items that have been discussed with the TCT over the last year in a PowerPoint presentation. This is TCT's opportunity to affect the building of the alternatives. EPA provided the PowerPoint presentation to the TCT group for review.

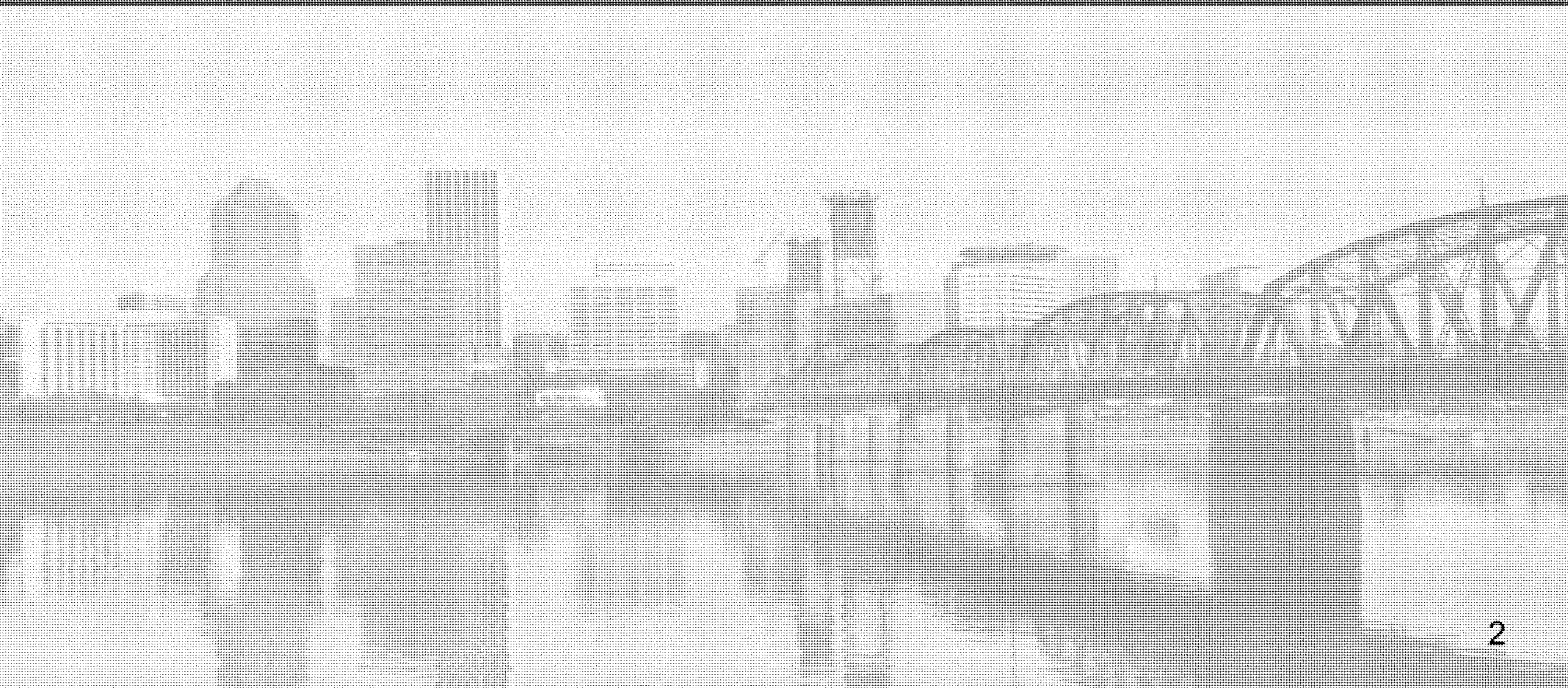
12:15 pm – Meeting adjourns.

To: Christopher, Anne[Christopher.Anne@epa.gov]
From: Conley, Alanna
Sent: Tue 1/12/2016 5:48:14 PM
Subject: Presentation for tonight - Im in the conf room. You can pull me to discuss and review anytime.
Info session base pres 2016 AC.pptx

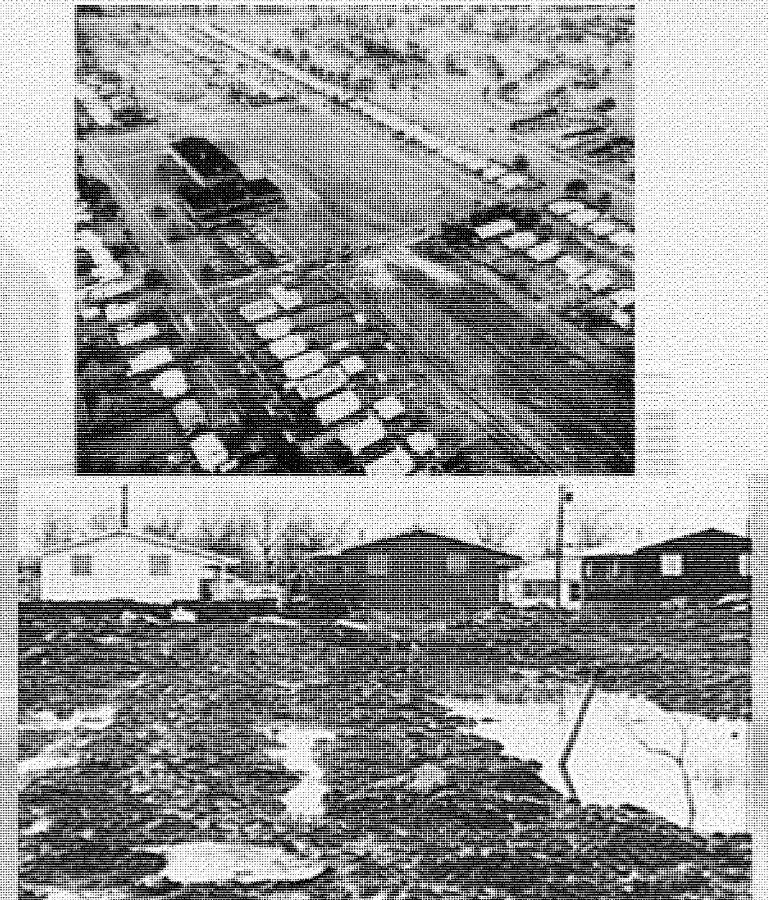
Bridge to the Portland Harbor cleanup



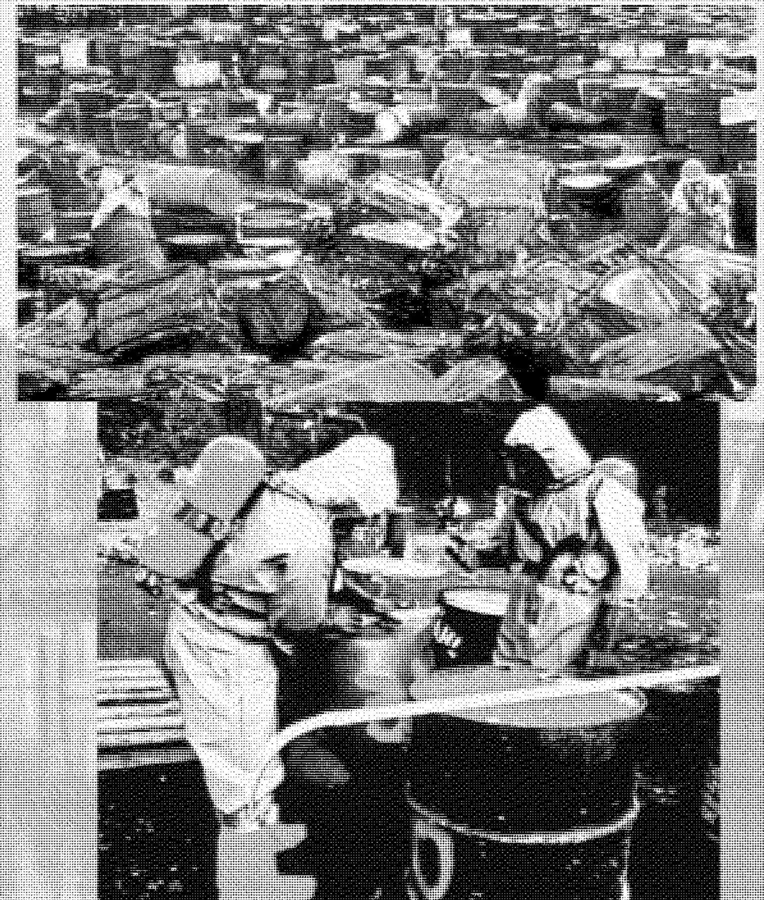
Overview



Superfund History



Love Canal
New York (1978)



Valley of the Drums
Kentucky (1979)

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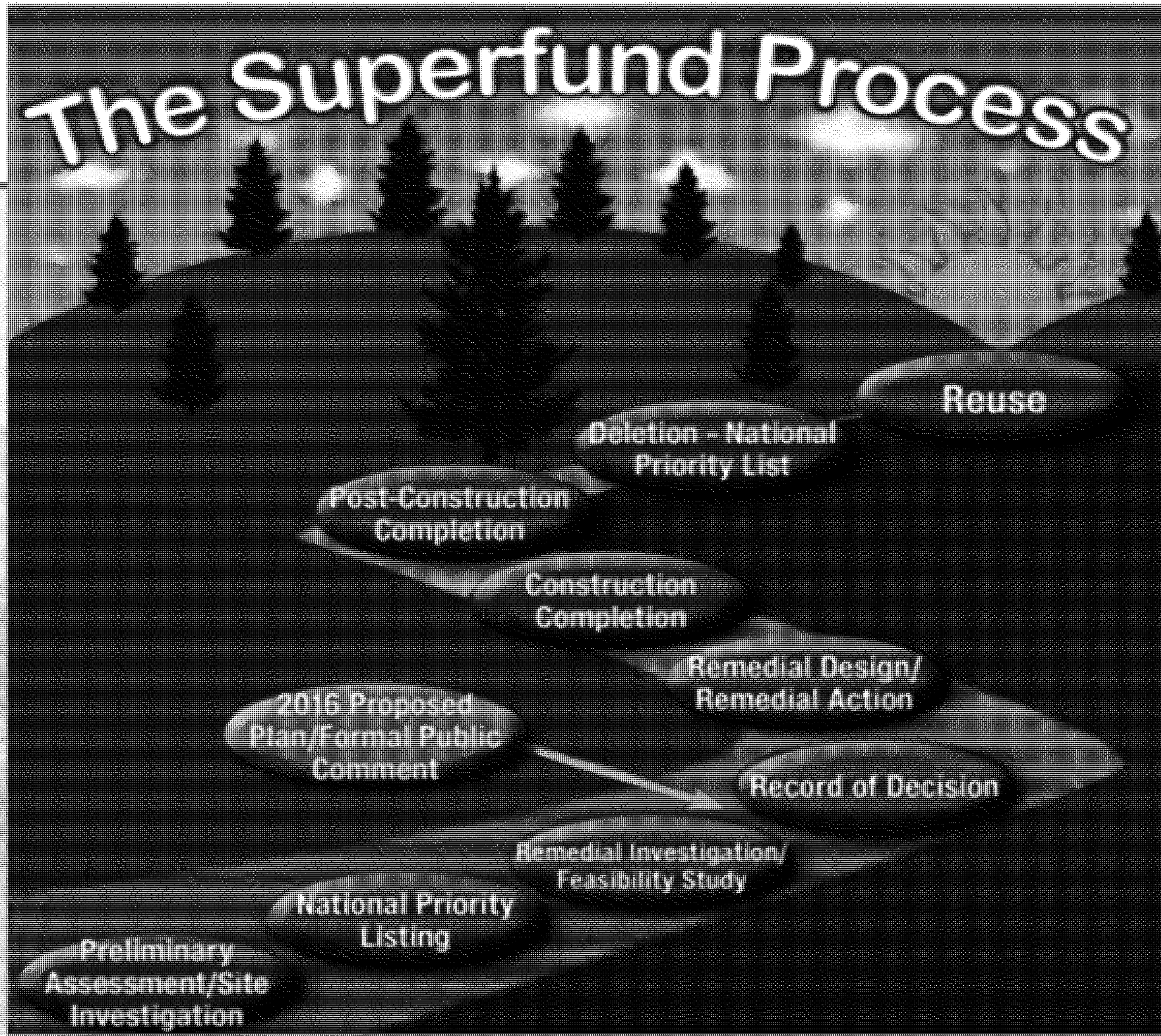
Goals of Superfund

- **Protect human health and the environment by cleaning up polluted sites**
- **Encourage participation of States and Tribal Governments in Superfund process**
- **Provide opportunity for community engagement**
- **Make responsible party pay for cleanup at Superfund sites**

Copyright Material / Ex. 4

https://www.google.com/search?q=image+of+the+simpsons+EPA+three+headed+fish&safe=active&rls=com.microsoft:en-us:IE-Address&tbm=isch&tbo=u&source=univ&sa=X&ei=oCxuVNKbEpLgsASi7oKYDw&ved=0CB8QsAQ&biw=1024&bih=664



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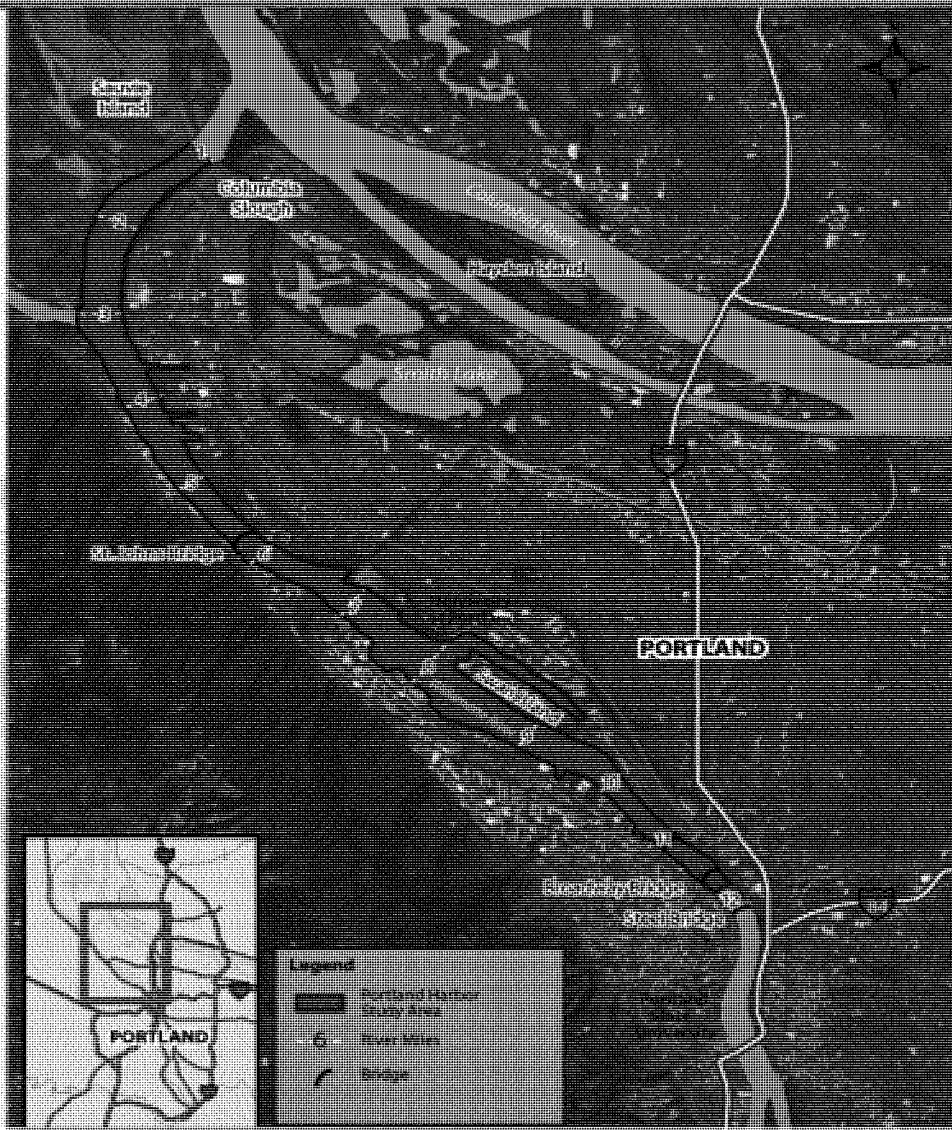
Portland Harbor History

- Location?
- History? Contaminants found?
- What are the risk to people and the environment?
- How can risk from the contamination be reduced?
- Who is potentially responsible for pollution? Are they involved?
- Agencies & Tribal Governments working with EPA?
- How do I get involved?

Portland Harbor Location and Uses



The following activities occur on the river today and will into the future:

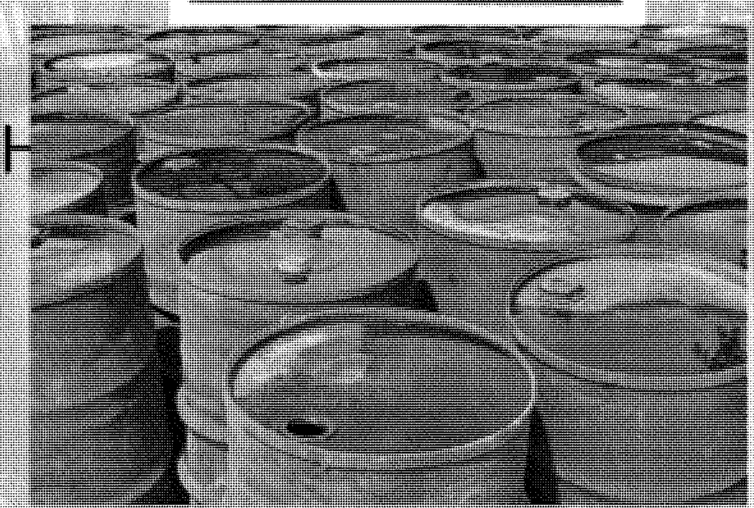
* Industry
* Recreation (boating, swimming, camping)
* Fishing
* Navigation
* Ceremonial practices
* Ecological habitat
* Tribal usual and accustom area
* Migratory corridor for ESA listed species (salmon)

Industrial Uses of Portland Harbor

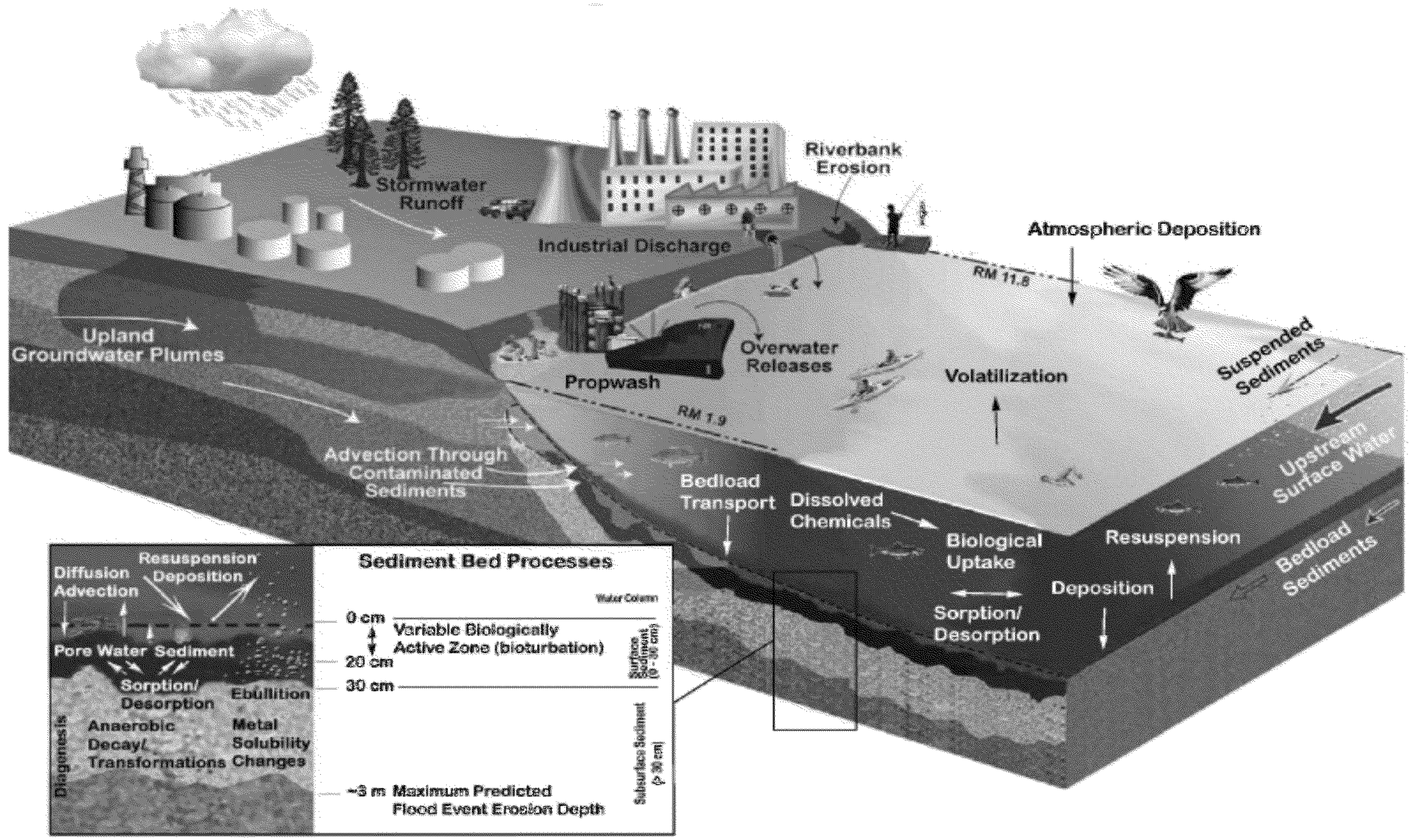
* Ship building, dismantling & repair
* Wood products & wood treating
* Chemical manufacturing and distribution
* Metal recycling, production & fabrication
* Manufactured gas production
* Electrical production & distribution
* Bulk fuel distribution & storage
* Asphalt manufacturing
* Steel mills, smelters & foundries
* Commodities shipping terminals
* Rail yards

Contamination From Past Industrial Use

- Metals
- Pesticides
- Herbicides
- Dioxins, Furans
- PCBs
- Polycyclic aromatic hydrocarbons (PAH



Contamination Pathway



SOURCE: Figure created from PDF provided by Integral Consulting, Inc.

The RESPIRATORY SYSTEM's function is to supply oxygen to the body and remove carbon dioxide. It includes the nasal passages, pharynx, trachea, bronchi, and lungs. Possible health effects of the respiratory system include asbestosis, lung cancer, chronic bronchitis, fibrosis, emphysema, and decreased oxygen supply in blood.

Possible Contaminants	Where do you find these?
Asbestos	Old insulation
Radon	The ground
Cadmium	Old batteries
Benzene	Degreasers
Carbon monoxide	Car exhaust, unvented or faulty furnaces
Soot	Furnaces, wood burning stoves

The RENAL SYSTEM's function is to rid the body of waste, to regulate the amount of body fluids, and to regulate the amount of salts in the body. It includes the kidneys, the urethra, the bladder, and the ureter. Possible health effects of the renal system include decreased formation of urine, decreased blood flow to kidney, decreased ability to filter the blood, prevented urine flow, kidney tissue damage, and kidney cancer.

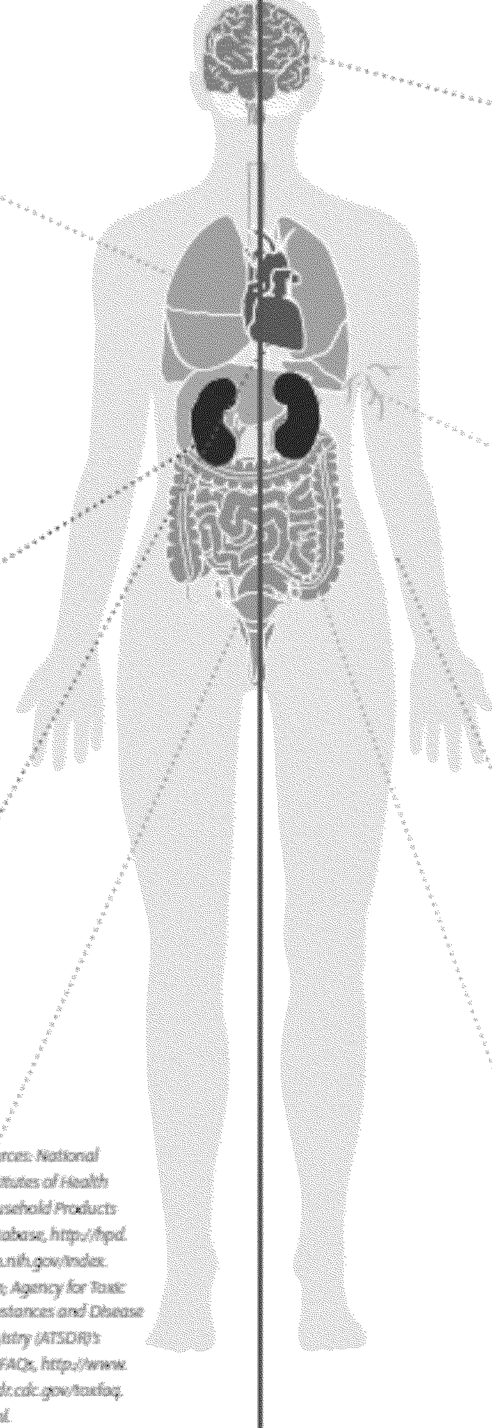
Possible Contaminants	Where do you find these?
Cadmium	Old batteries, cigarette smoke
Lead	Old paint, outdated plumbing
Mercury	Thermostats, thermometers, some fish
Uranium	Food & water, proximity to nuclear testing sites
Chlorinated hydrocarbon solvents (TCE, PCE, PCT)	Degreasers, paint removers, dry cleaning solutions

The CARDIOVASCULAR SYSTEM's function is to move nutrients, gases, and wastes to and from the body, to help stabilize body temperature, and to fight diseases and infections by transporting white blood cells to important areas. It includes the heart, blood, arteries, veins, and capillaries. Possible health effects include heart failure and the inability of blood to carry the necessary oxygen to the body.

Possible Contaminants	Where do you find these?
Carbon monoxide	Car exhaust, unvented or faulty furnaces
Carbon disulfide	Industrial production
Nitrates	Fertilizers
Methylene chloride	Auto part cleaners, paint removers

The REPRODUCTIVE SYSTEM's function is to produce egg and sperm cells, to nurture a developing fetus, and to produce hormones. For males it includes the testicles, seminal vesicles, prostate gland, and the penis. For females it includes the uterus, bladder, vagina, Fallopian tubes, ovaries, and the cervix. Possible health effects of the reproductive system include decreased ability to have a baby, increased baby deaths, increased birth defects, and infertility (the inability to have children).

Possible Contaminants	Where do you find these?
Methyl mercury	Some fish, coal-burning power
Carbon monoxide	Car exhaust, unvented or faulty furnaces
Lead	Old paint, outdated plumbing



Sources: National Institutes of Health Household Products Database, http://hpd.nlm.nih.gov/index.htm; Agency for Toxic Substances and Disease Registry (ATSDR)'s ToxFAQs, http://www.atsdr.cdc.gov/toxfaq.html.

The NERVOUS SYSTEM's function is to transmit messages from one part of the body to another. It includes the central nervous system (the brain and spinal cord) and the peripheral nervous system. Possible health effects of the nervous system include inability to move, loss of feeling, confusion, and decreased speech, sight, memory, muscle strength, or coordination.

Possible Contaminants	Where do you find these?
Arsenic	Pressure treated wood
Cadmium	Discarded batteries
Carbon monoxide	Car exhaust, unvented or faulty furnaces
Cyanide	Rat poison

The IMMUNE SYSTEM's function is to protect the body from tumor cells, environmental substances, and invading viruses or bacteria. It includes the lymph system, bone marrow, white blood cells, and the spleen. Possible health effects of the immune system include overreaction to environmental substances (allergy), immune system slow down or failure, and autoimmunity (autoimmunity causes the body to attack itself – which makes it more likely to have an over-reaction or infection).

Possible Contaminants	Where do you find these?
Mercury	Thermostats, thermometers, some fish
Lead	Old paint, outdated plumbing
Pesticides	Unwashed fruits and vegetables
Polychlorinated biphenyls (PCBs)	Industrial waste, fish from contaminated water
Polycyclic aromatic hydrocarbons (PAHs)	Cigarette smoke, vehicle exhaust, asphalt roads

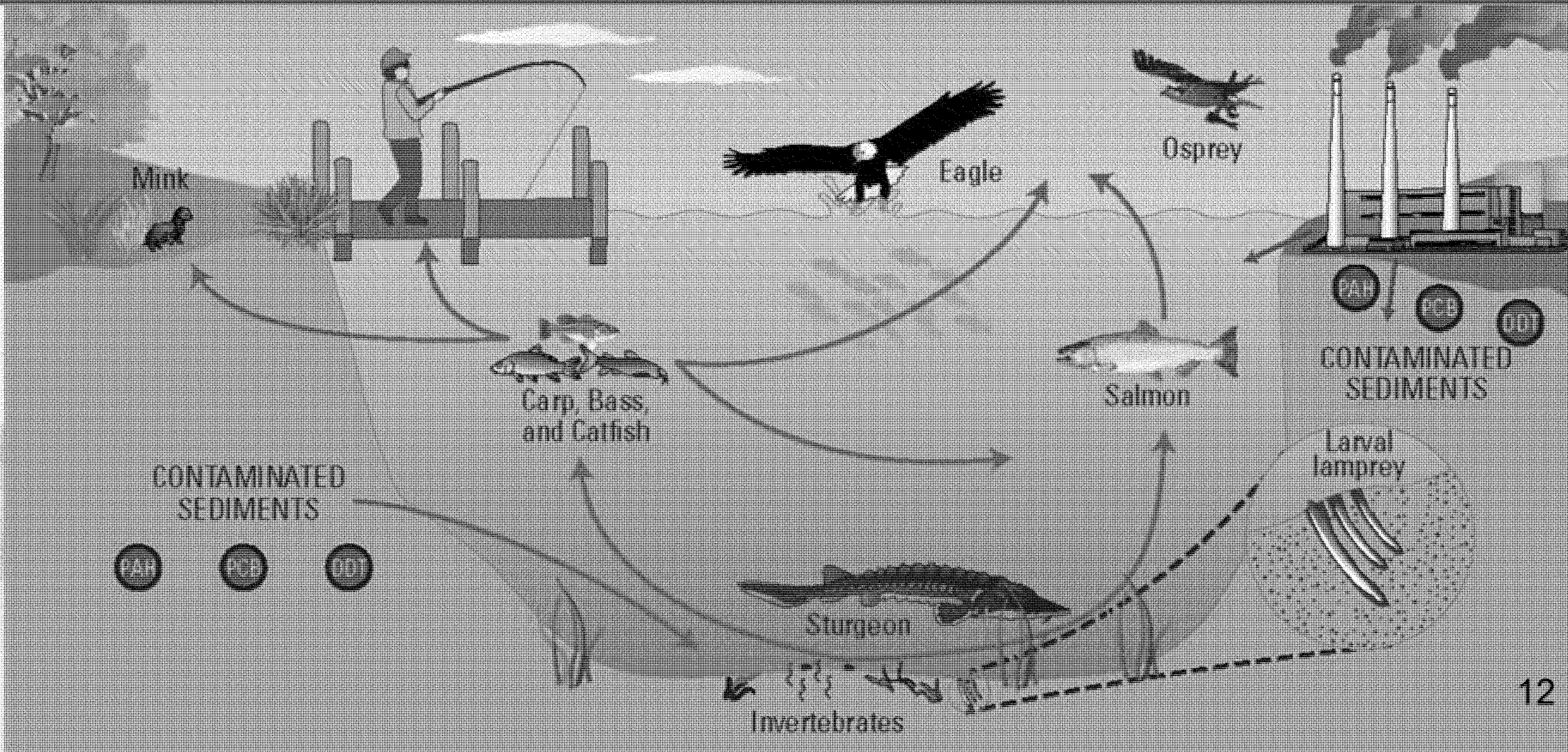
The SKIN serves as a barrier to germs and other substances, prevents dehydration, and regulates body temperature. Possible health effects of the skin include irritation, rash, redness or discoloration, dermatitis, and health effect related to other systems and organs due to contamination through the skin.

Possible Contaminants	Where do you find these?
Nickel	Cement
Mercury	Thermostats, thermometers, some fish
Arsenic	Pressure treated wood
Chromium	Paints, industrial production
Polychlorinated biphenyls (PCBs)	Industrial waste, fish from contaminated water
VOC (volatile organic compounds)	Fumes from gasoline, paint, adhesives, building supplies

The HEPATIC SYSTEM's function is to break down food and store nutrients, to make proteins which are essential for blood to clot, and to purify the body of drugs, contaminants, or chemicals. It includes the liver and its veins. Possible health effects of the hepatic system include liver damage, tumors, accumulation of fat (steatosis), and death of liver cells.

Possible Contaminants	Where do you find these?
Carbon tetrachloride	Adhesives
Methylene chloride	Auto part cleaners, paint removers
Vinyl chloride	Pipe sealer

Health Risks



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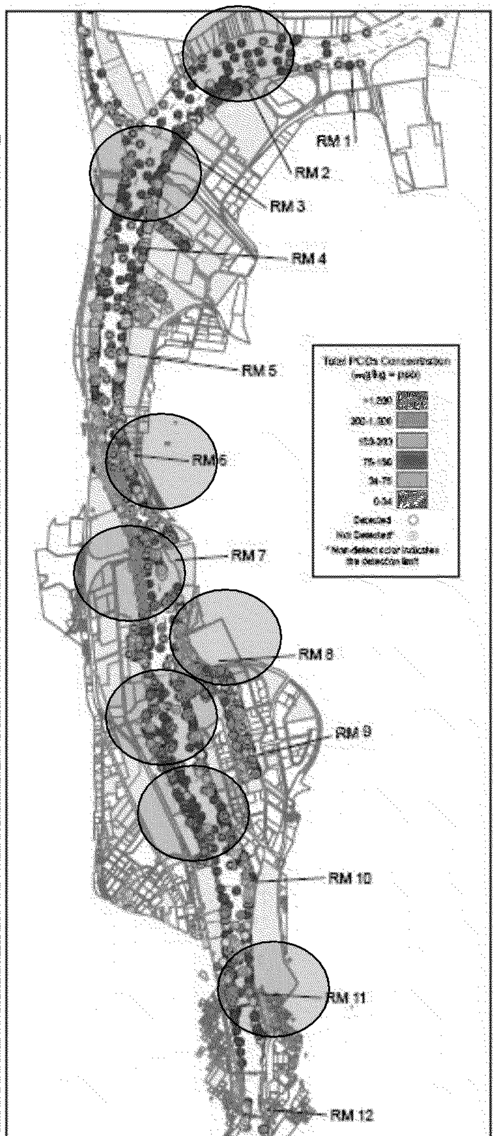
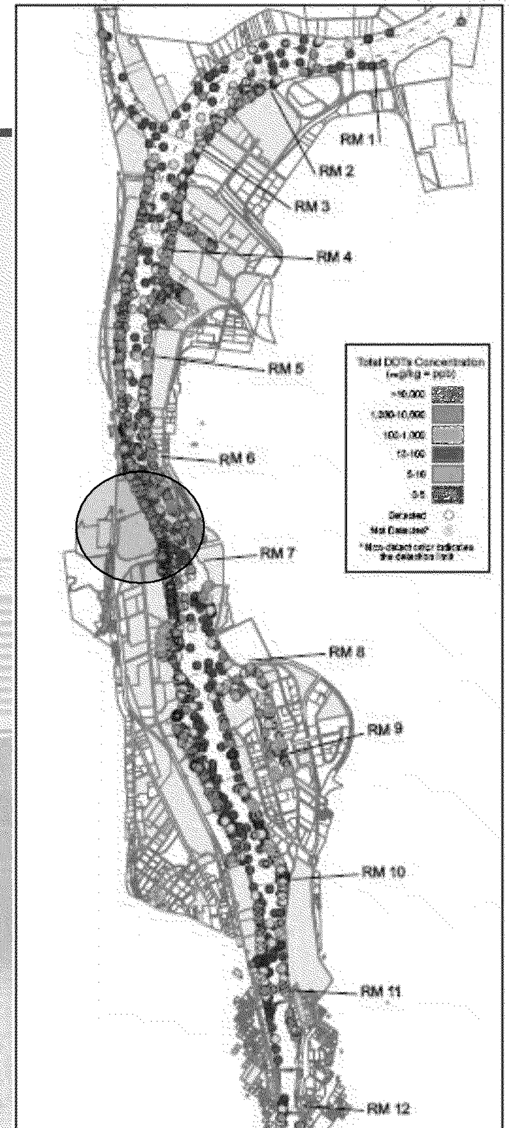
Health Risks

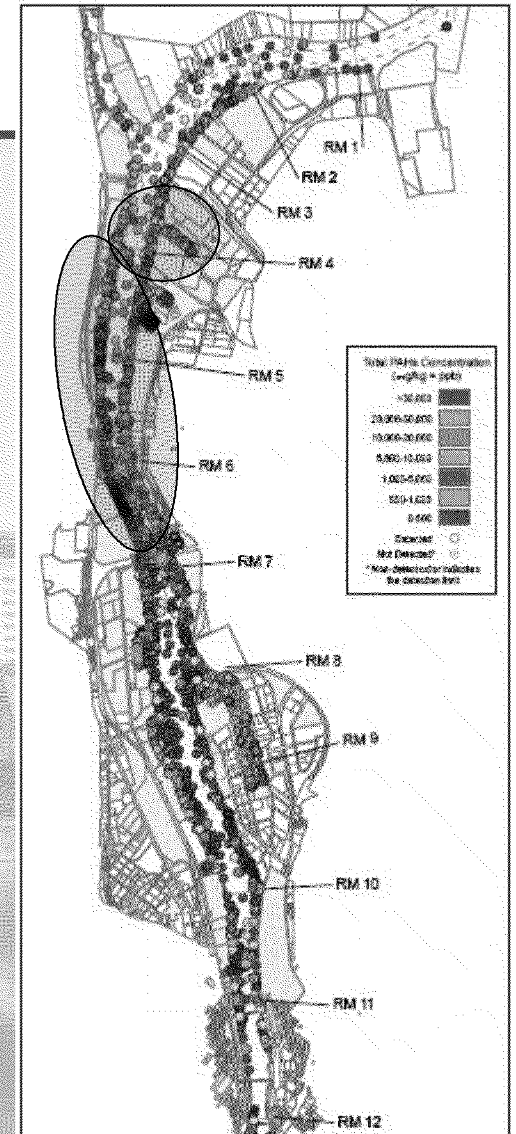
Where is the Contamination?



Total PCBs



DDx Pesticides



Total PAHs

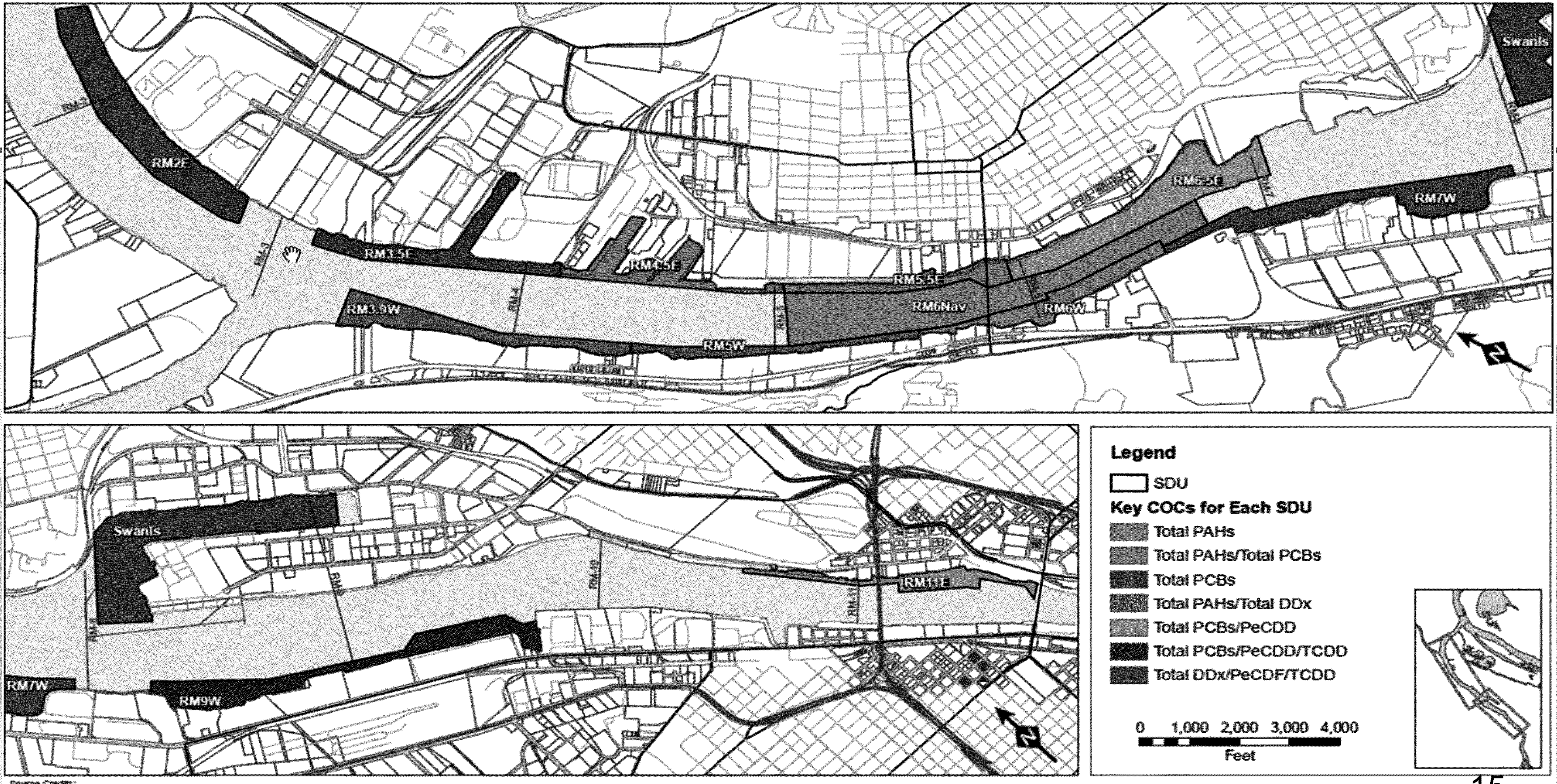
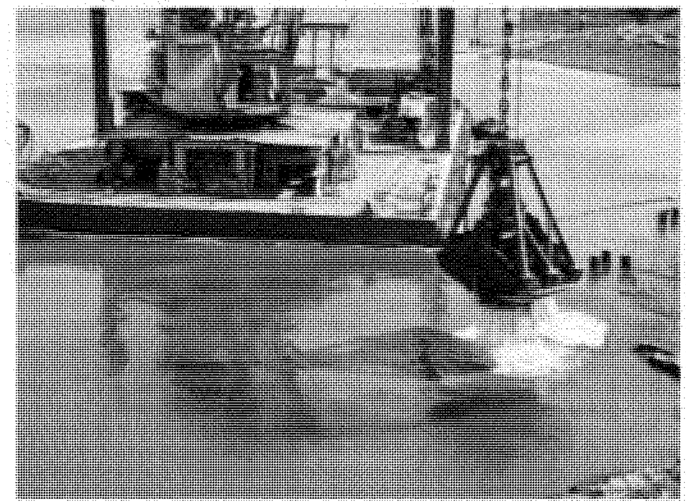


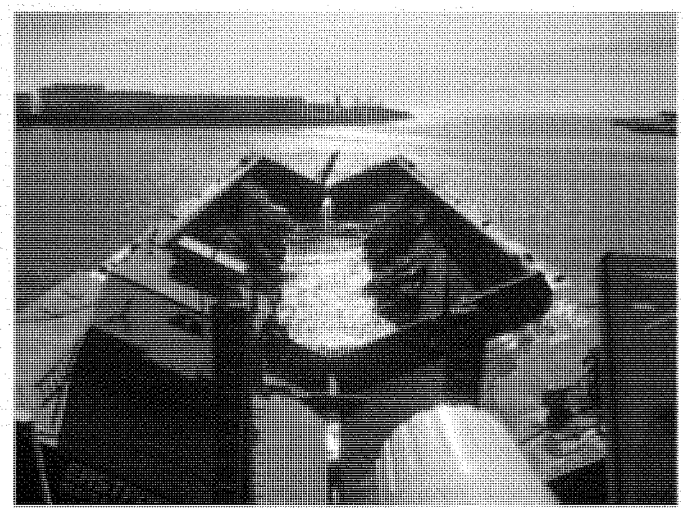
Figure 4.1-2. Sediment Decision Units and Key COCs

Examples of Active Cleanup Technologies

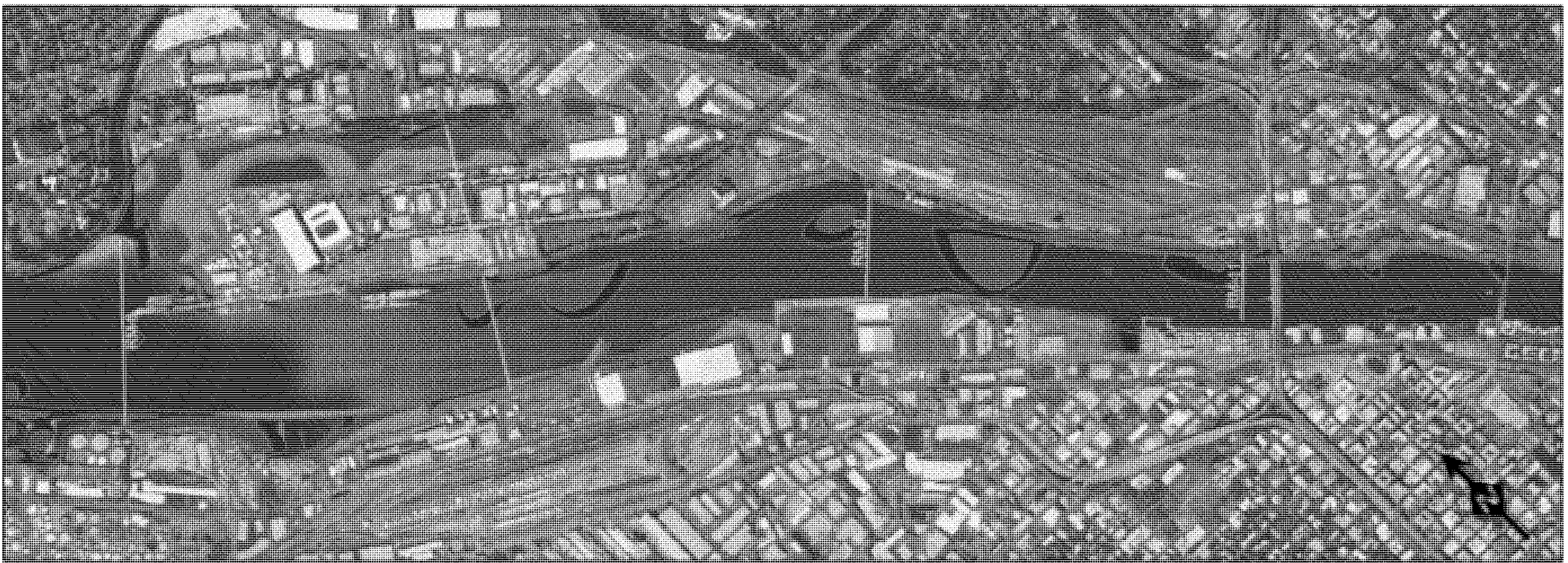
Dredging



Capping



Treatment



Legend

Site with Known Contaminated Riverbank

Alternative SMAs

Alternative B

Alternative C

Alternative D

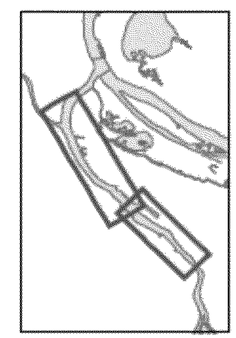
Alternative E

Alternative F

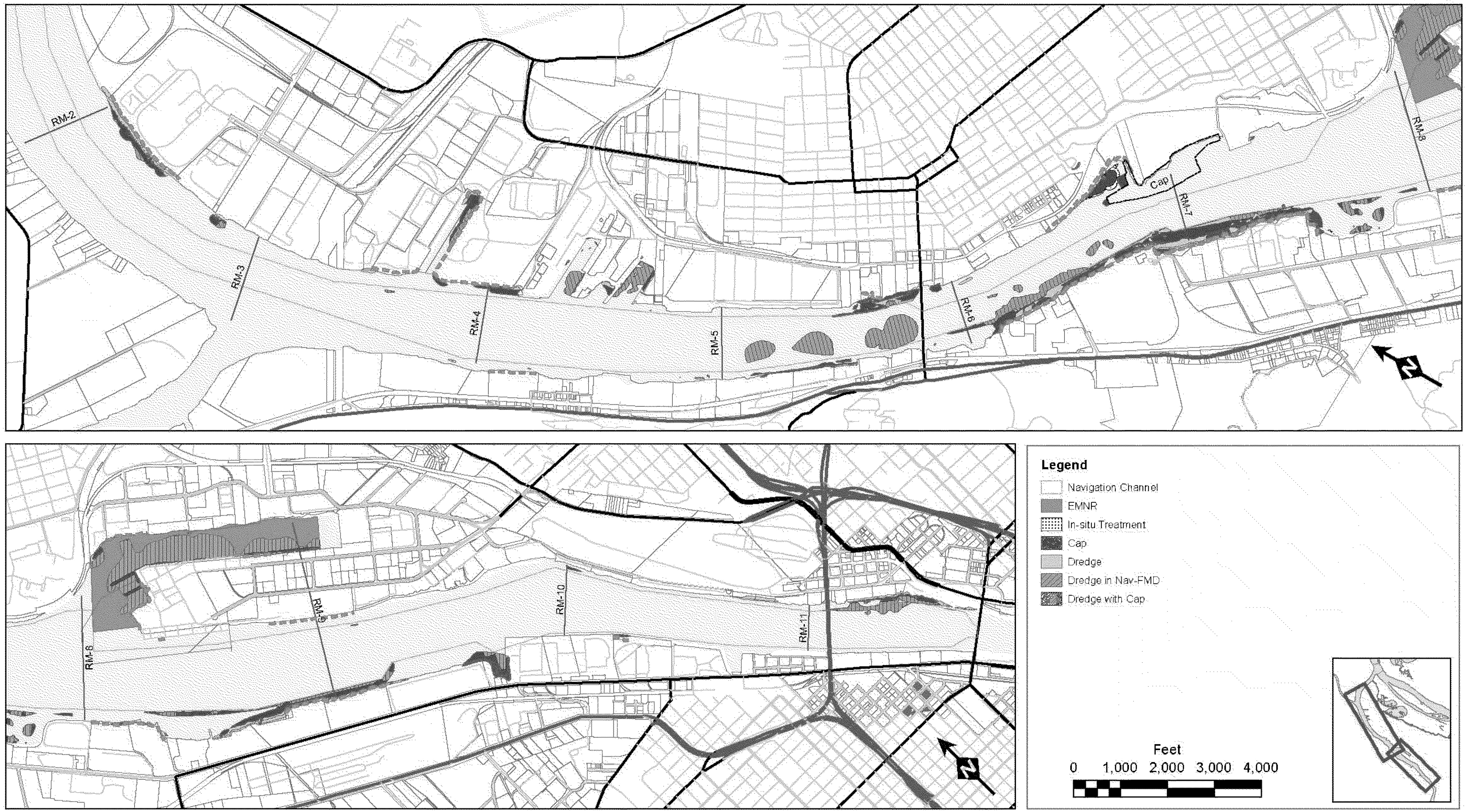
Alternative G

0 1,000 2,000 3,000 4,000

Feet



Source Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

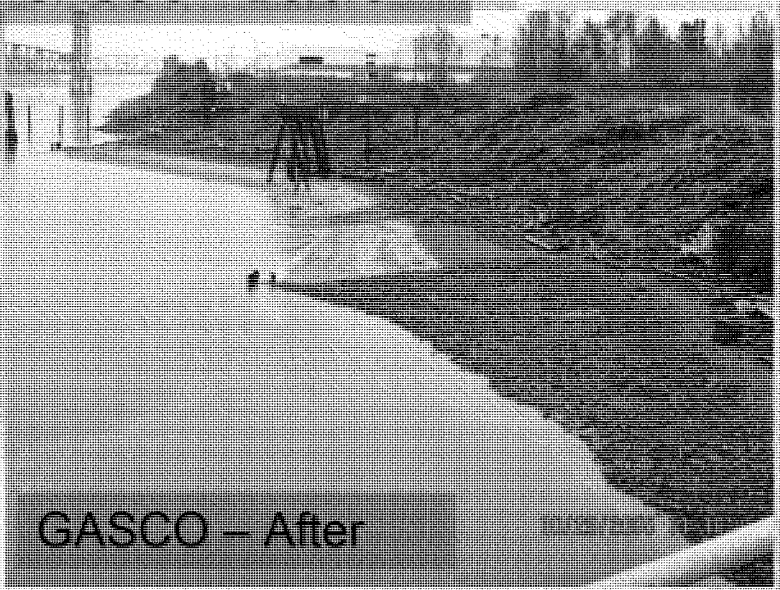


Projects\Portland Harbor\GIS\MapDocuments\Workshop Figures\Fig11-X_Tech-Assign-Site-wide.mxd; Created by: MLF

Figure 11-X. Selected Technology Assignments, Site-Wide

Clean-up Decisions


GASCO – Before


GASCO – After

When is it clean?

What are the clean-up goals?

What technology do we use?

Where do we do the work?

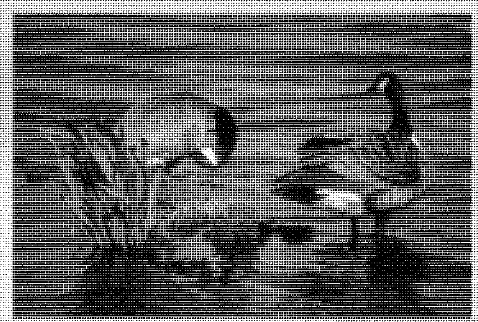
What should we be cautious of?

Terminal 4 – Before


Terminal 4 – After


EPA's 9 Criteria

- **EPA evaluates each cleanup method to make sure:**
  - Protective of human health and the environment in the long term
  - Meets state and federal requirements
  - Minimizes risks to cleanup workers and communities
  - Reduces risk from contaminants
  - Is doable and has a reasonable cost
  - We hear and consider comments from ODEQ and the community



What is being done to Clean-up Portland Harbor?

*Estimated dates

We are here

2000 --------→ 2010 | 2011 | 2015 | 2016* | end of 2016*

There Is A Problem

Portland Harbor Listed as Superfund Site (2000)

Sampling, Analysis, Early Actions, Uplands Cleanup (2000-)

What and where are the risks?

Remedial Investigation (RI) and Risk Assessment

Human Health & Ecological Risk Assessment 2013

How could it be cleaned up?

Draft Feasibility Study (FS)

EPA's Proposed Clean-up Plan

Proposal for formal public comment

•Tribal Consultations

•Formal Public Comment Period

Final Decision: How It Will Be Cleaned Up

A's Record of Decision (ROD)

Harbor Cleanup

Portland Harbor Partners

- Oregon Department of Environmental Quality
  - Lead agency for upland source control efforts
  - Support agency for in-water RI/FS
- Natural Resource Trustees
  - Indian Tribes – Nez Perce, Umatilla, Warm Springs, Yakama, Siletz, Grand Ronde
  - Department of the Interior/Fish and Wildlife Service
  - National Oceanic Atmospheric Administration (NOAA)
  - Oregon Department of Fish and Wildlife

Who is responsible / who pays?

- Lower Willamette Group is a coalition of Portland Harbor businesses and public agencies who stepped forward in 2001 to participate in site investigations.
- EPA has identified about 150 parties that are potentially responsible for site cleanup costs.
- Potentially responsible parties negotiate an agreement to fund and implement the site's cleanup.

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Ways YOU Can Get Involved

- Participate in the additional information sessions, go to EPA's website and review detailed information

- Provide comments and attend a meeting during the public comment period for Proposed Plan starting in April

Goals

- Cleaner river and beach areas that can be enjoyed by community
- Reduce contaminants in river sediments, riverbanks and fish
- Fish that that people can safely eat
- Promote community involvement during all Superfund cleanup phases
- Monitor for effectiveness
- Reduce contaminated groundwater migration

Thank You!

- **Kristine Koch**
  206-553-6705
  koch.kristine@epa.gov
- **Alanna Conley**
  503-326-6831
  conley.alanna@epa.gov
- **Annie Christopher**
  503-326-6554
  christopher.annie@epa.gov
- **Elizabeth Allen**
  206-553-1807
  allen.elizabeth@epa.gov

EPA's Portland Harbor Web page: www.epa.gov/region10/portlandharbor

To: Conley, Alanna[conley.alanna@epa.gov]
From: Christopher, Anne
Sent: Tue 10/27/2015 4:43:25 PM
Subject: FW: NRRB/CSTAG pre-call/webinar for Portland Harbor review
2015-10-27 CSTAG_NRRB Presentation - Portland Harbor.pptx

Alanna,

Kristine's presentation to NRRB/CSTAG is today at 10am. Here is the powerpoint in case you aren't here today. We can listen to it in the team room if you want.
Annie

From: Koch, Kristine
Sent: Tuesday, October 27, 2015 9:30 AM
To: Legare, Amy; OSWER OSRTI RRB; OSWER OSRTI CSTAG; Fonseca, Silvina; Charters, David; Christopher, Anne; Allen, Elizabeth; Field, Jeff
Cc: Su, Chunming; Sprenger, Mark; Ells, Steve; Gustavson, Karl; Prince, John; Lambert, Matthew; Openchowski, Charles; Sivak, Michael; Campbell, Richard; Greenberg, Marc; Barth, Edwin; Wharton, Steve; Bergen, Barbara; Corbett, Chris; Keckler, Kymberlee; Simes, Benjamin; Jasinski, Michael; Grandinetti, Cami; Luzecky, Hollis; Hiltner, Allison; Ammon, Doug; Jewett, David; Tomchuk, Doug
Subject: RE: NRRB/CSTAG pre-call/webinar for Portland Harbor review

All - Here is the presentation that I'll be going over today.

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-122
Seattle, Washington 98101-3140

(206)553-6705
(206)553-8581 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

-----Original Appointment-----
From: Legare, Amy
Sent: Friday, September 11, 2015 6:56 AM
To: Legare, Amy; OSWER OSRTI RRB; OSWER OSRTI CSTAG; Fonseca, Silvina; Charters, David; Christopher, Anne; Allen, Elizabeth; Koch, Kristine; Field, Jeff
Cc: Su, Chunming; Sprenger, Mark; Ells, Steve; Gustavson, Karl; Prince, John; Lambert, Matthew; Openchowski, Charles; Sivak, Michael; Campbell, Richard; Greenberg, Marc; Barth, Edwin; Wharton, Steve; Bergen, Barbara; Corbett, Chris; Keckler, Kymberlee; Simes, Benjamin; Jasinski,

Michael; Grandinetti, Cami; Luzecky, Hollis; Hiltner, Allison; Ammon, Doug; Jewett, David; Tomchuk, Doug
Subject: NRRB/CSTAG pre-call/webinar for Portland Harbor review
When: Tuesday, October 27, 2015 1:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: DCRoomPYS5261VTC/OSRTI-Potomac-Yard-South/ Personal Privacy / Ex. 6

Sorry everyone the package is not ready for prime time. The Portland Harbor team will be working double time to finish the site information package for distribution next week. I've postponed this call for one week. Hope you can make it.

https://epa.connectsolutions.com/nrrb

The package for this review should be made available on *next week.*

Region 10 will provide a PowerPoint presentation followed by Q&A.

Portland Harbor Pre-Call/Background

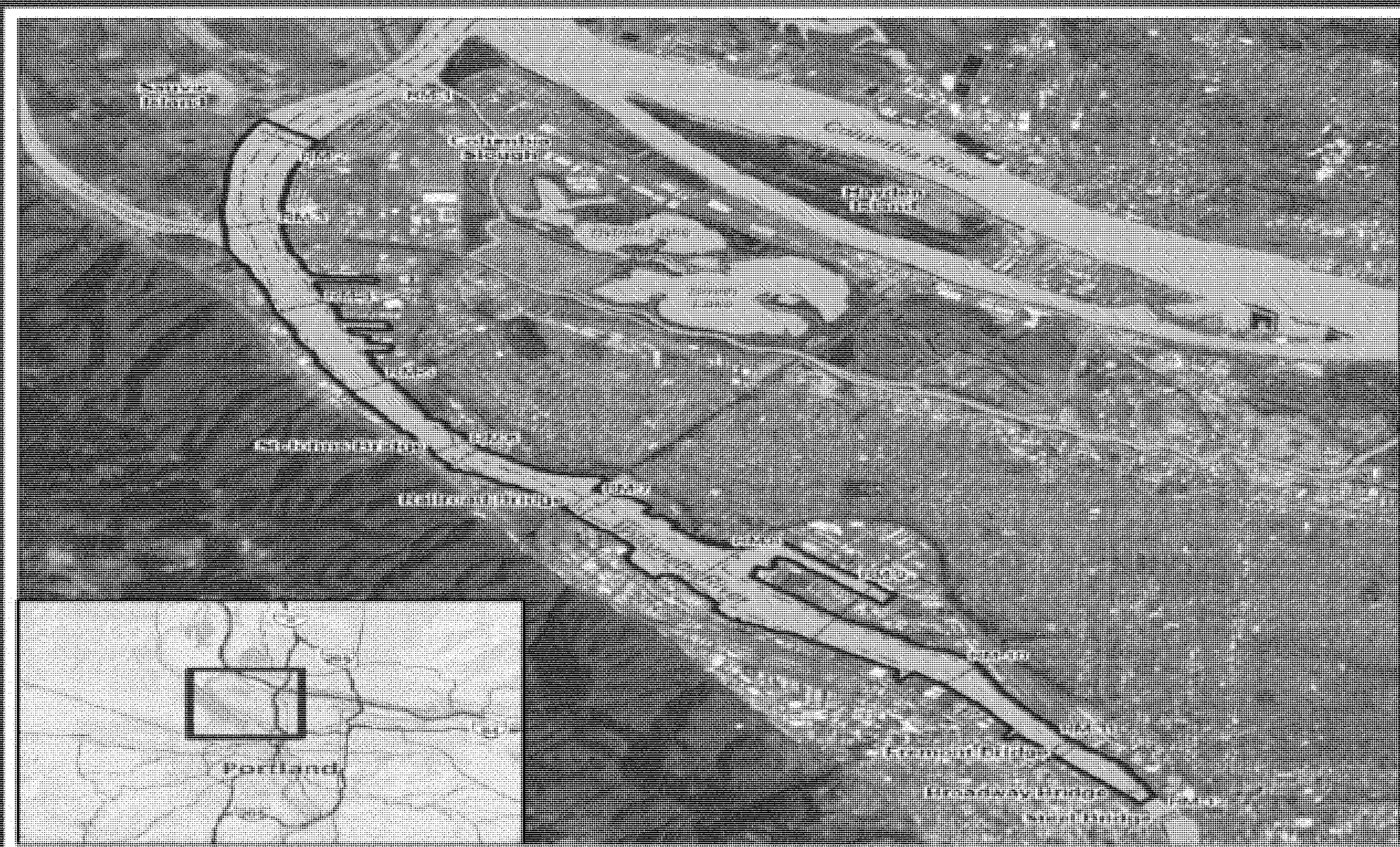
Presentation to the
CSTAG/NRRB
October 27, 2015

Kristine Koch, U.S. EPA Region 10

Portland Harbor

Background Information

Portland Harbor Superfund Site



Conceptual Site Model

- Big Site
  - 10 River Miles
  - 2,190 acres
  - Industrial land use
  - Authorized Navigation Channel
  - Below Downtown Reach – DEQ lead

Conceptual Site Model, cont.

- Complex
  - Over 90 COCs
  - 150 PRPs
  - Multiple sources
  - Large variation in hydrodynamics and grain size
  - Multi-media
    - Sediment contamination
    - Groundwater contamination
    - Surface water contamination

Draft, Deliberative, Do not cite or quote

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Conceptual Site Model, cont.

- High risks
  - Greatest risk from consumption of resident fish
  - Harbor-wide: PCBs are the primary contributor to risk from fish consumption
  - River Mile Scale: Dioxins/furans are a secondary contributor risk and hazard
  - Non-cancer risks are driver for cleanup
  - PCBs, DDx, dioxin and PAHs are most ecologically significant
  - Benthic Community – toxicity, TBT, metals, PAHs, PCBs, pesticides, cyanide and BEHP

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Portland Harbor

Remedial Action Levels vs. PRGs

RALs vs. PRGs

- Entire site (2,190 acres) exceeds PRGs
- Allows for range of alternatives in FS
  - Less action to more action
  - Identify sediment management areas – capping/dredging
- Levels of Active Risk Reduction
  - Maximum incremental reduction
  - Point of minimum concentration change
- MNR/EMNR to achieve RG
- Background considered

Focused COCs

- Subset of COCs with most widespread footprint
  - PCBs
  - PAHs
  - Dioxins/furans
    - PeCDD
    - PeCDF
    - TCDD
  - DDx

Example RAL Curve

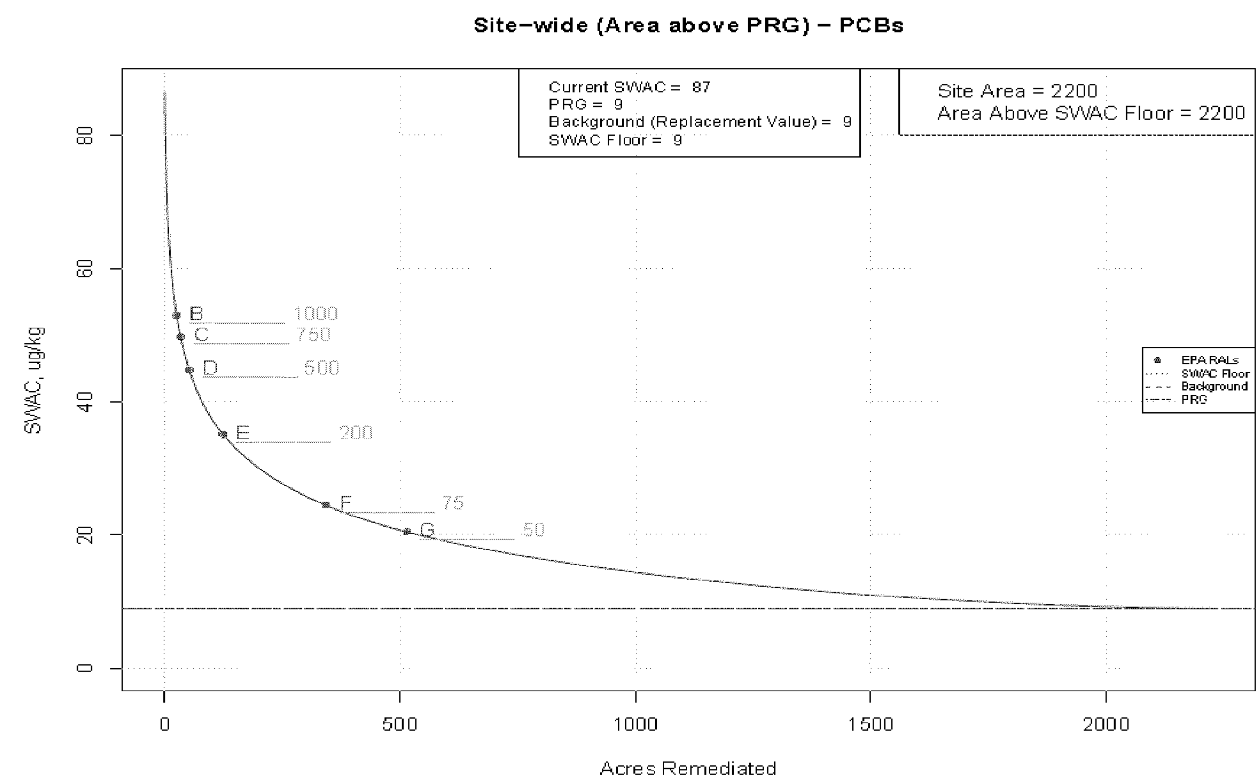

Figure 3.3-1
PCBs Site-wide RAL Curves

Draft, Deliberative, Do not cite or quote

Remedial Action Levels

Contaminant	B	C	D	E	F	G
PCBs	1,000	750	500	200	75	50
Total PAHs*	170,000	130,000	69,000	35,000	13,000	5,400
1,2,3,7,8-PeCDD	1	1	1	0.2	0.2	0.009
2,3,4,7,8-PeCDF	0.003	0.002	0.0008	0.0008	0.0008	0.0008
2,3,7,8-TCDD	0.002	0.002	0.002	0.0006	0.0006	0.0006
DDx	650	550	450	300	160	40

*Equivalent to cPAH RALs in draft FS.
All units µg/kg.

Portland Harbor

Assignment of Technologies

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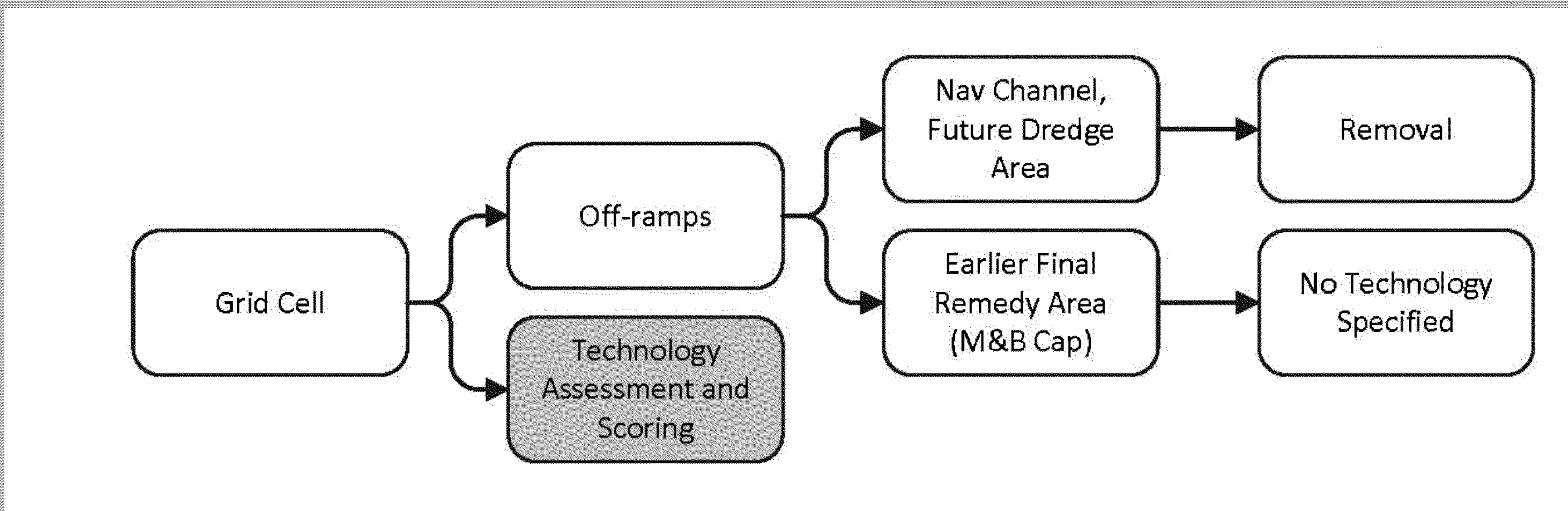
Technology Assignment

Objective: Develop a process that evaluates remedies based on environmental conditions:

* hydrodynamics, sediment bed characteristics, and anthropogenic conditions
* Uses a decision tree / multi-criteria decision approach to indicate an appropriate technology:
* EMNR/in-situ treatment
* Cap – engineered cap with/without active component
* Dredging

Outcome: Process indicates appropriate technology based on analysis... **It does not select a remedy**.

Overview of Technology Assignment Process



Technology Assignment Matrix

Criteria Scoring

- +1 = technology favorable
- 0 = technology neutral
- -1 = technology unfavorable
- NC = not applicable

Technology Assessment Scoring		Dredge	Armor Cap	Cap
Hydrodynamics	Wind/Wave Zone?	1	0	NC
	Erosive?			-1
	Depositional? (<2.5cm/year or Subsurface:Surface Ratio>2)?	-1	1	1
	Shallow?	1	-1	0
Sediment Bed Characteristics	Slope 15-30%?	1	1	NC
	Slope >30%		0	
	Rock, Cobble, Bedrock Present?	-1	1	1
Anthropogenic Influences	Structures/Pilings?	-1	1	1
	Prop Wash Zone?	1	0	NC
	Moderate or Heavy Debris?	-1	0	1
	Technology Score	Sum Scores for Each Technology		

Hydrodynamics Criteria

Erosive OR Wind/Wave Zone
- Erosive = shear stress exceeds critical shear stress for 2 year recurrence (flood) event – sediment texture as modeled by LWG
- Wind/wave zone – near shore areas – layer provided by LWG as part of FS GIS data

Depositional
- Either depositional (> 2.5cm/yr) May 2003 to 2009 Surveys (same period LWG preferred for model calibration)
  OR
- Average Subsurface/Surface RAL concentrations > 2
  - Interpolate 4 RAL COCs – surface vs. subsurface
  - Surface or subsurface must exceed RAL G
  - Average of remaining RAL ratios

Shallow
- Shallow - <1 m at low water level, >2 feet NAVD 88

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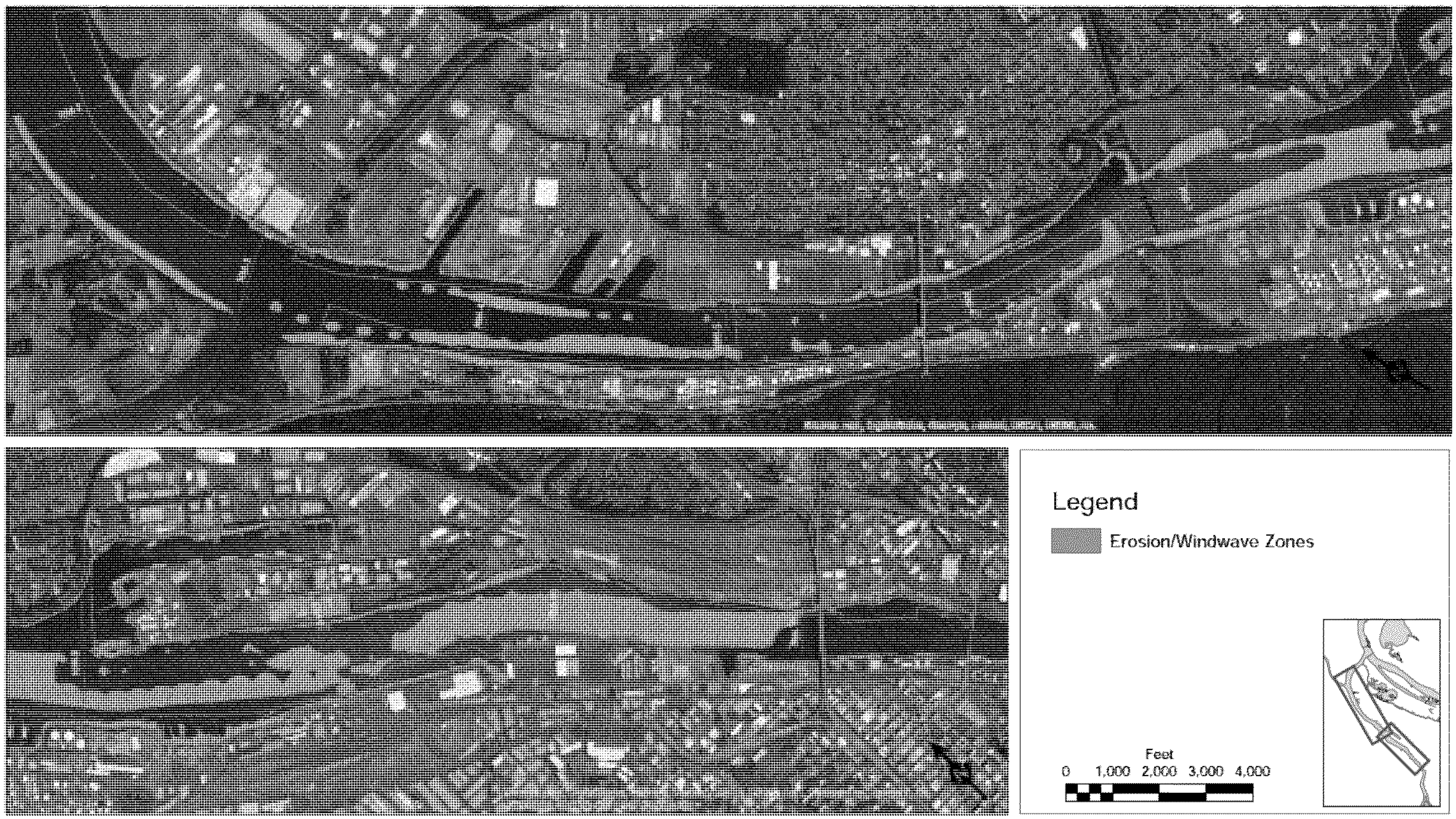
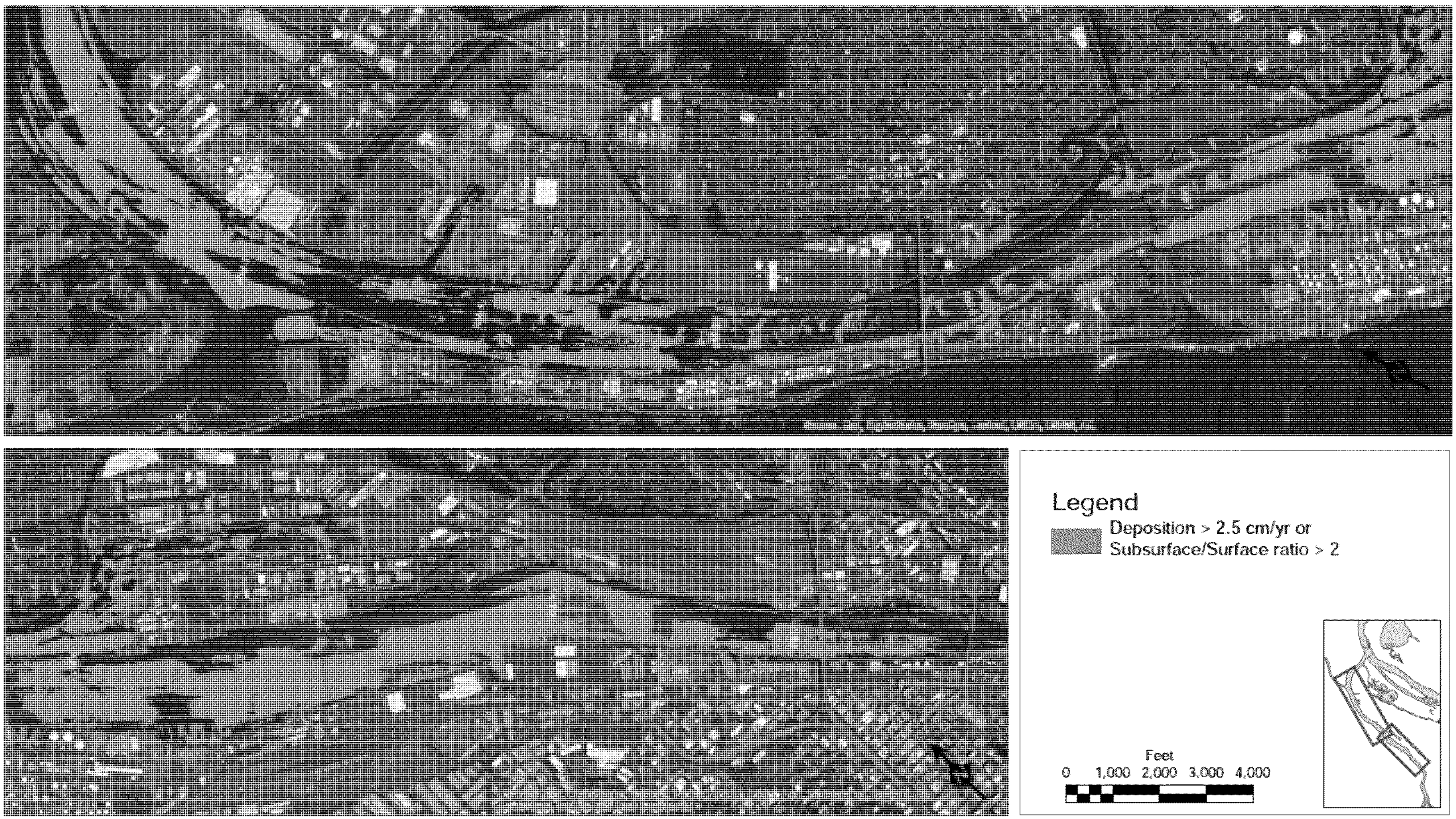
Wind/Wave Zone



Erosion/Windwave Zones

Depositional



Depositional Areas

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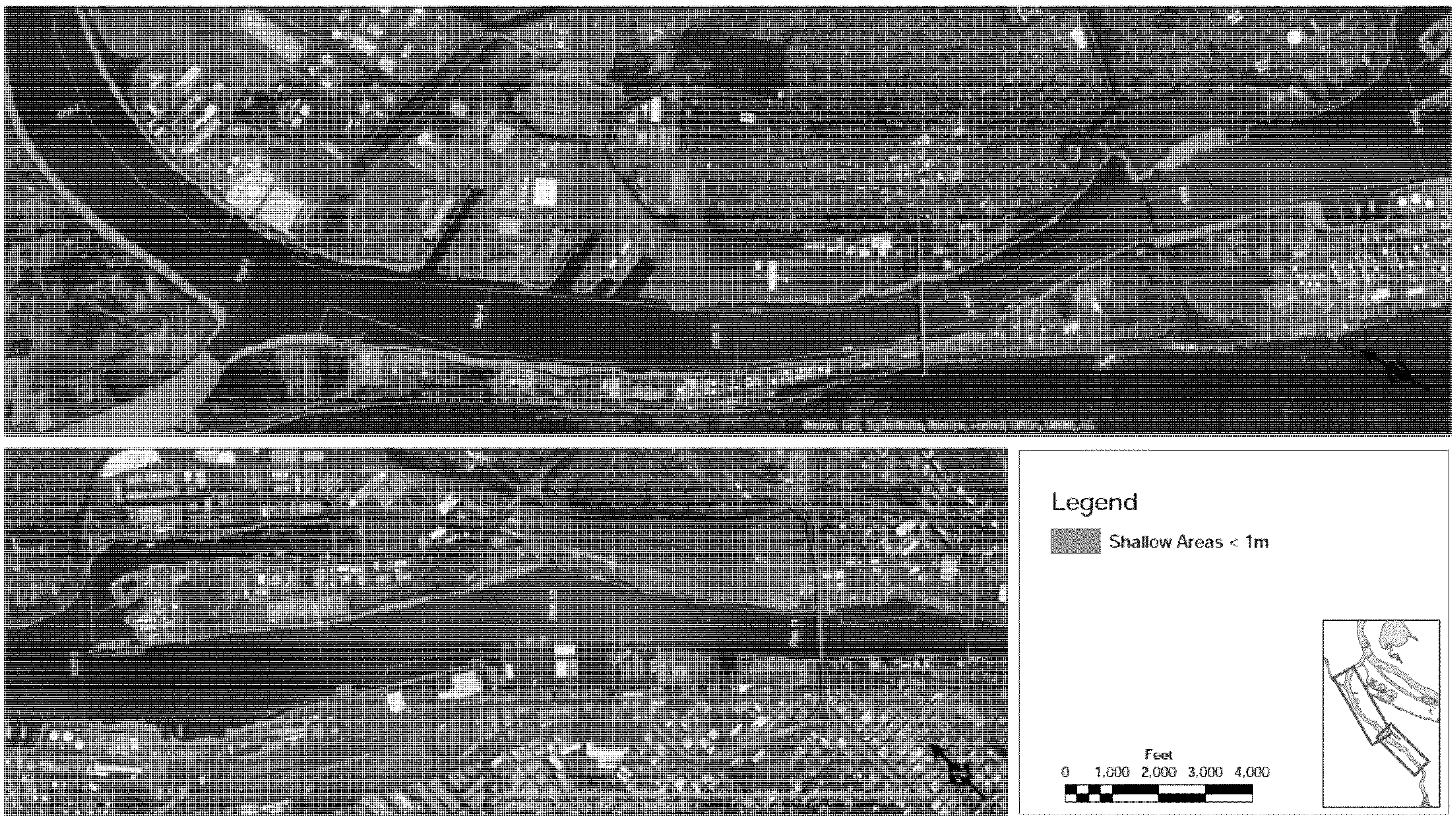
Shallow Areas



Shallow Areas

Draft, Deliberative, Do not cite or quote

Sediment Bed Characteristics Criteria

- Slope > 15 % (Based on LWG 2009 Bathymetry)
- Rock, Cobble, Bedrock within potential dredge prism
  - none identified by LWG after EPA request

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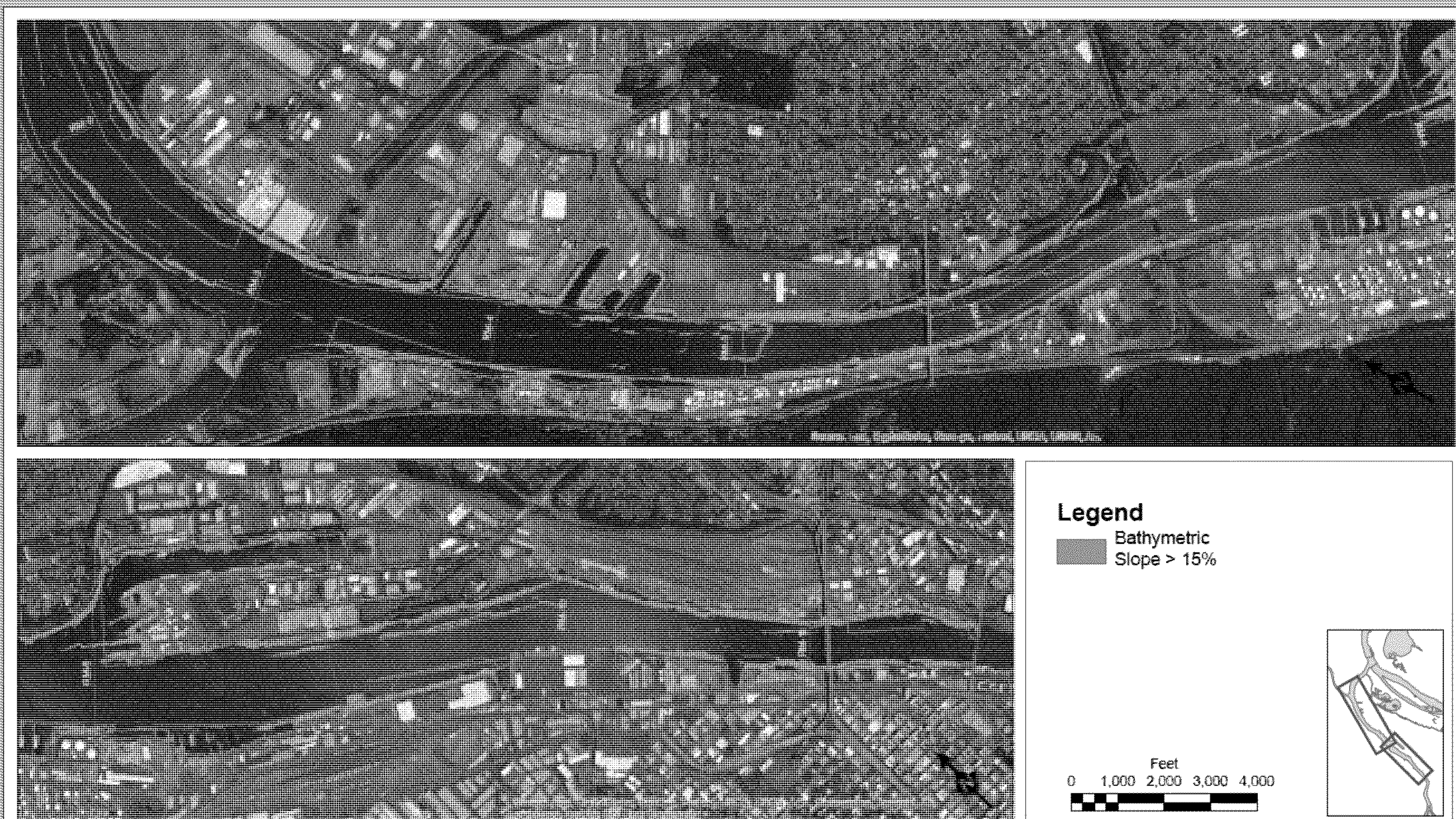
Bathymetry/Slope

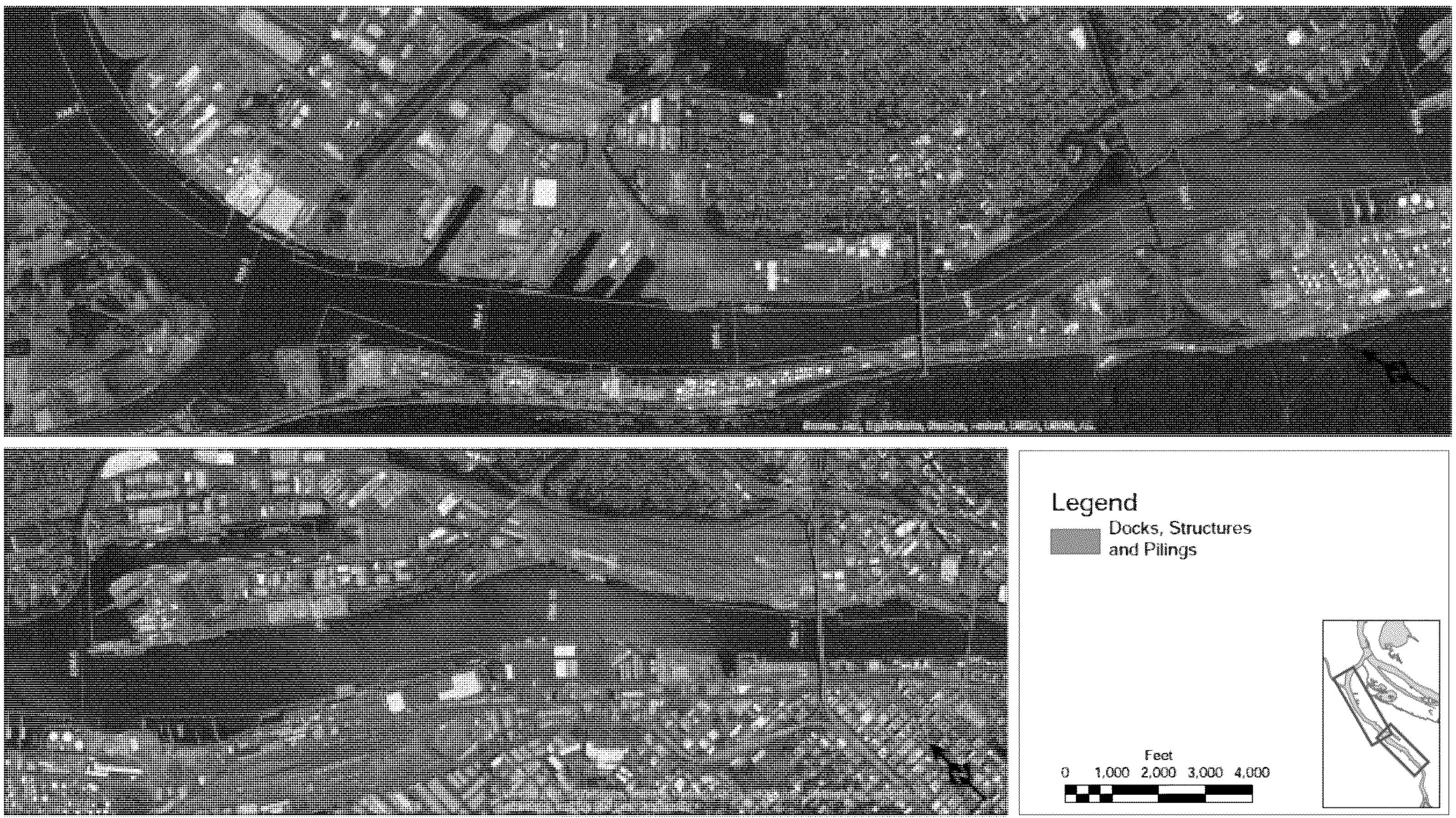


Bathymetric Slope

Anthropogenic Influences Criteria

- Structures and Pilings (LWG provided + pilings and dolphins from debris layer)
- Prop Wash Zone – (LWG provided)
- Debris as indicated by side/scan sonar (LWG provided)

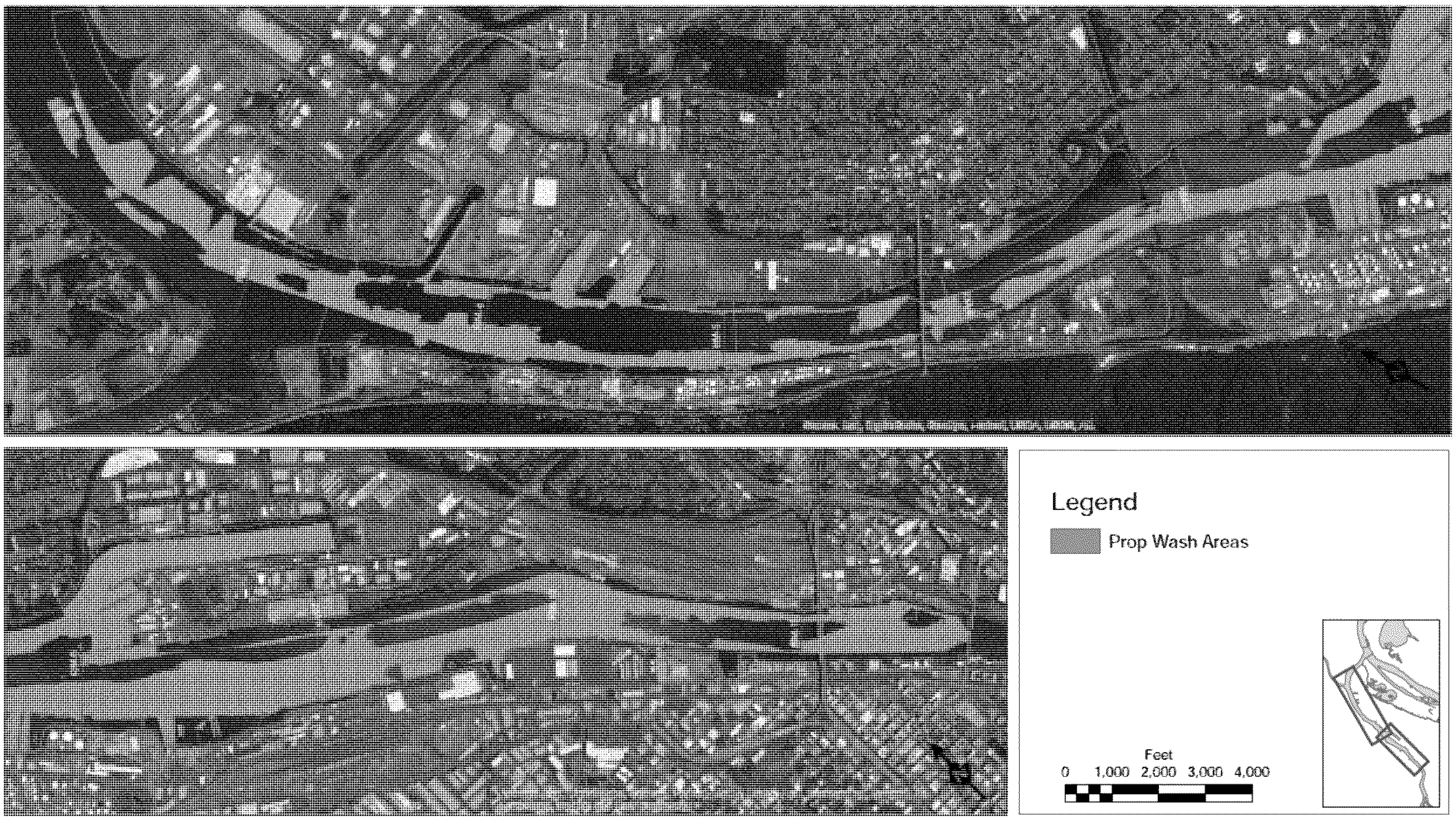
Structures and Pilings



Docks, Structures and Pilings

Draft, Deliberative, Do not cite or quote

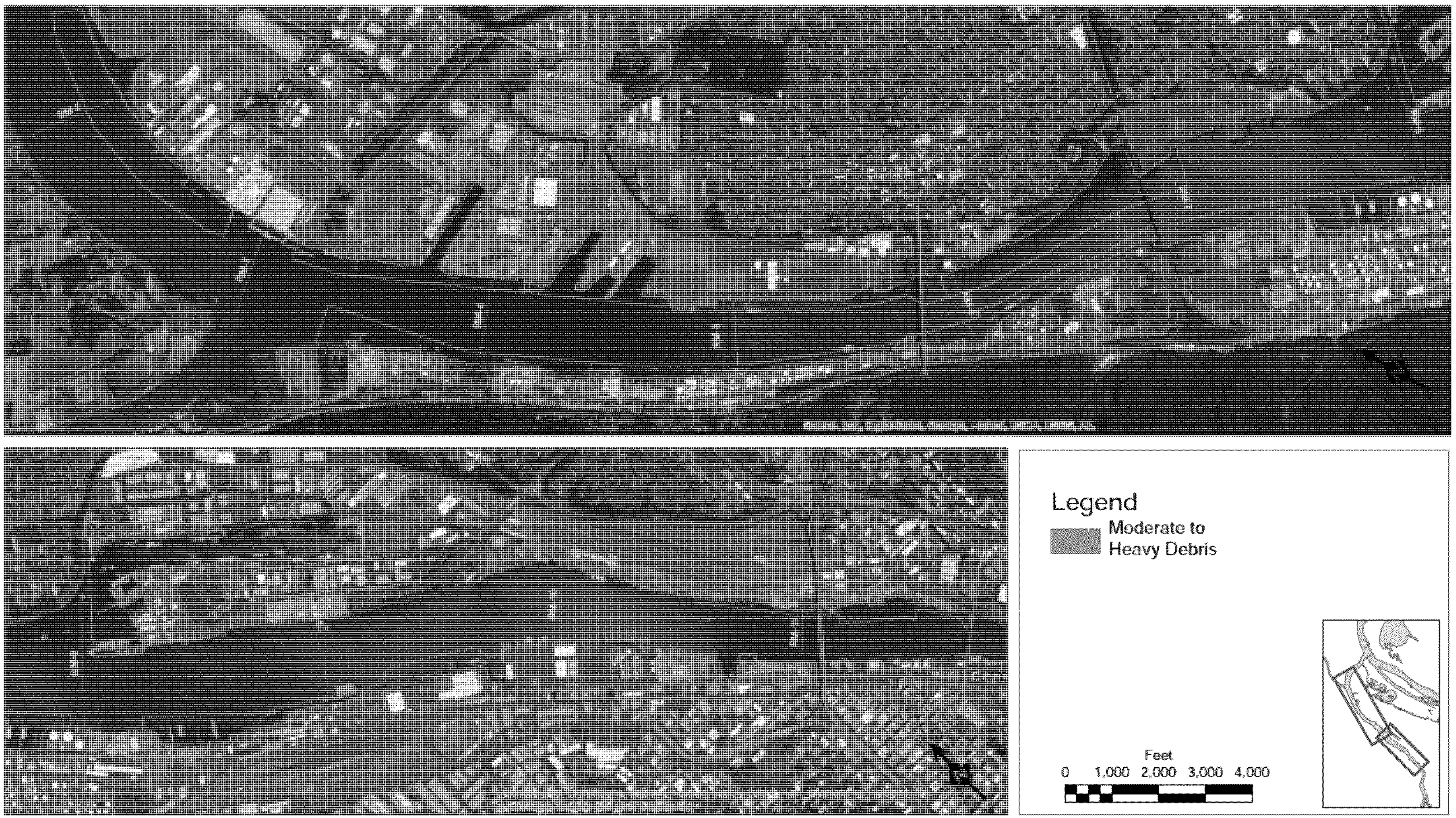
Prop Wash Areas



Prop Wash Areas

Draft, Deliberative, Do not cite or quote

Debris

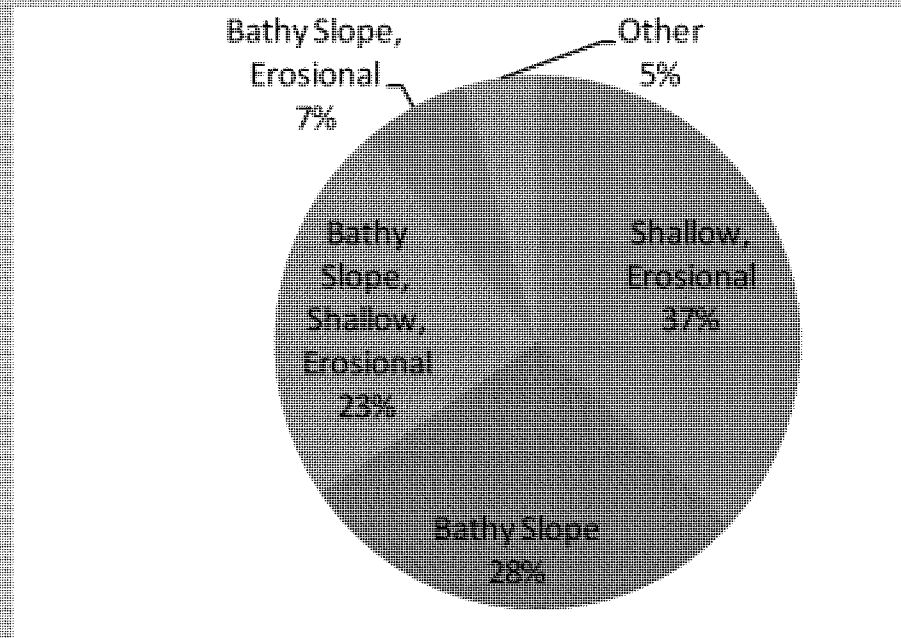


Debris

Draft, Deliberative, Do not cite or quote

Conclusions

- In areas outside "off-ramps", dredging was selected due to these criteria:



- Primary drivers were: erosional, bathy slope, and shallow.
- Generally, multiple LoEs; single LoE in 32% of areas.

Portland Harbor

Site Areas

Site Areas

* Based on receptors
* Account for receptor mobility
* Focus on high concentration areas
* Delineate areas of capping/dredging

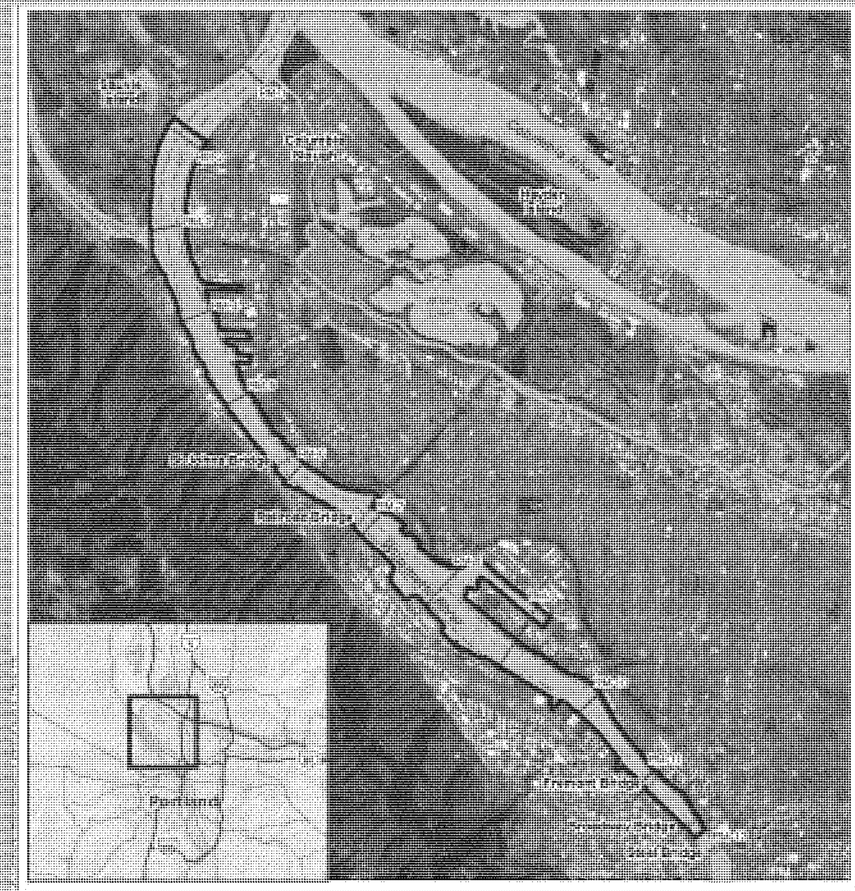
Site-wide

Example Receptors

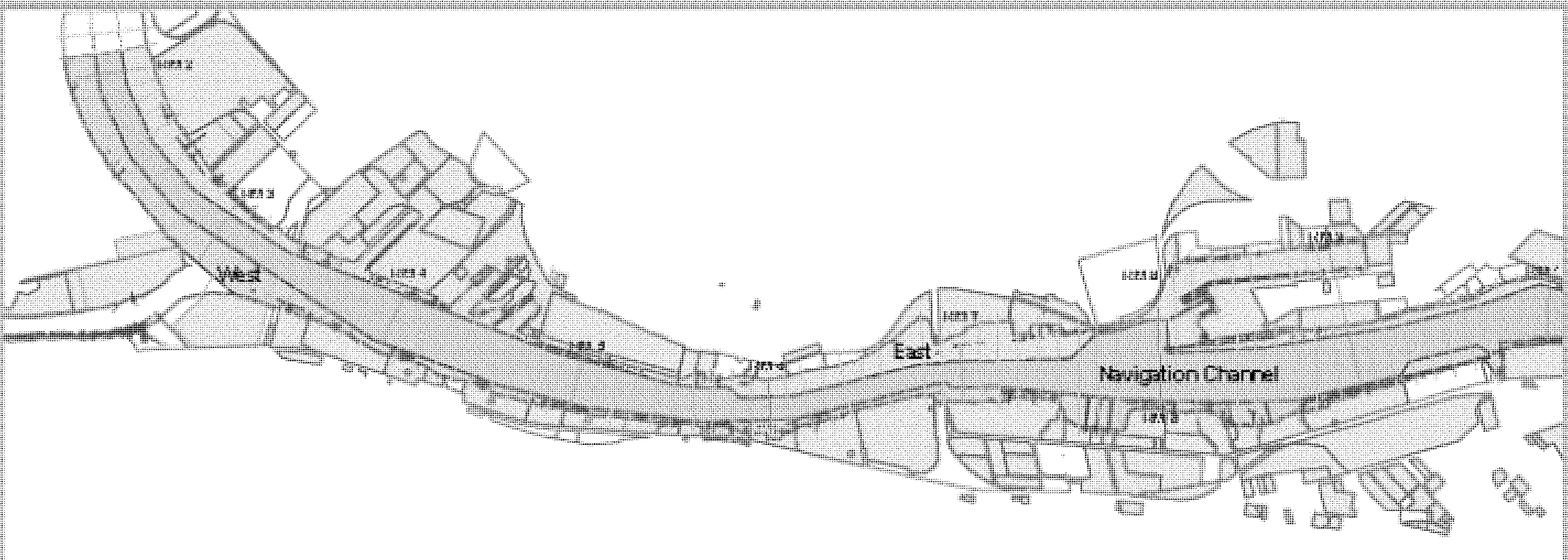
* Subsistence & Tribal Fishers
* Large-home range Fish
* Bald Eagle

Size

* ~10 RM
* 2,190 Acres



River Zones



- Navigation Channel
- Swan Island Lagoon

0.1 to 0.2 River Mile

Receptors

- Sculpin
- Crayfish
- Benthic

Size

- Rolling 0.2 RM in River Zones

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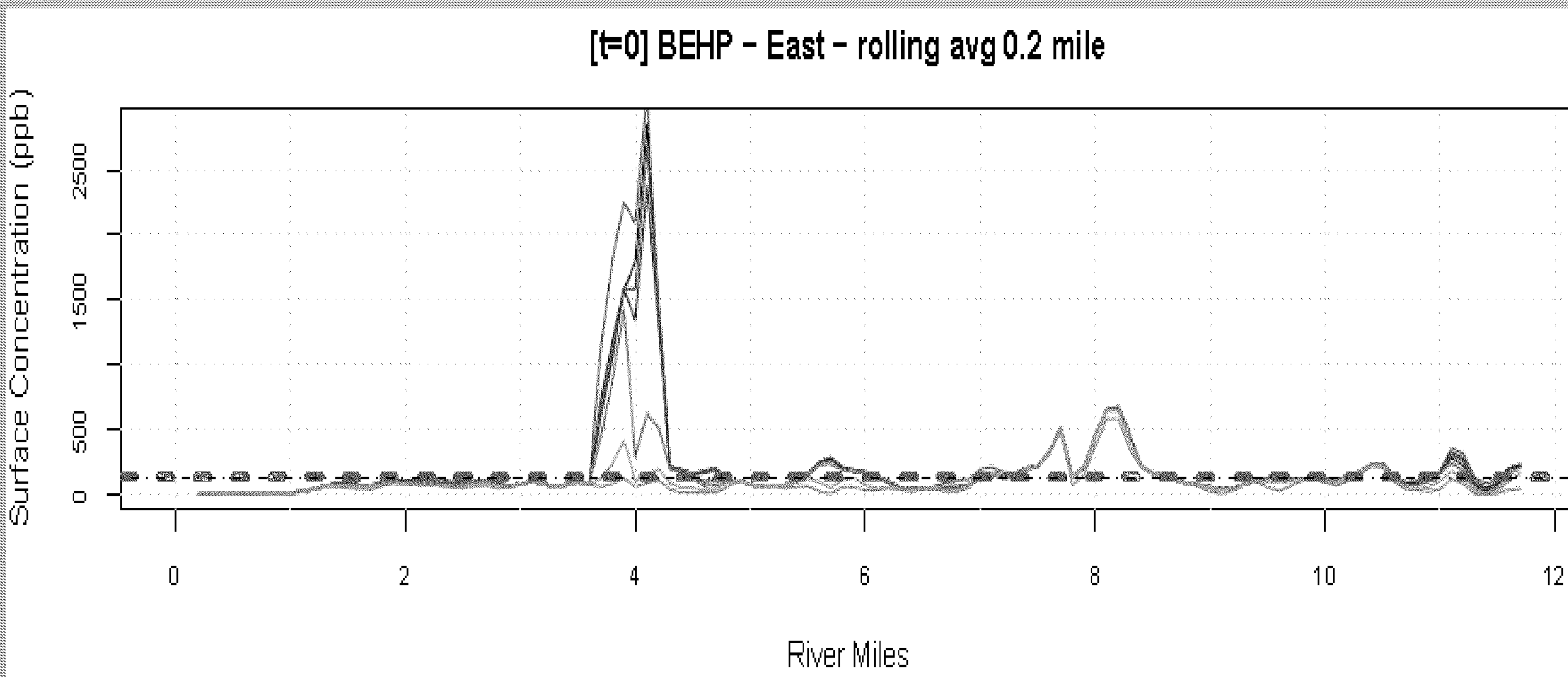
Example Rolling 0.2 RM



0.5 River Mile

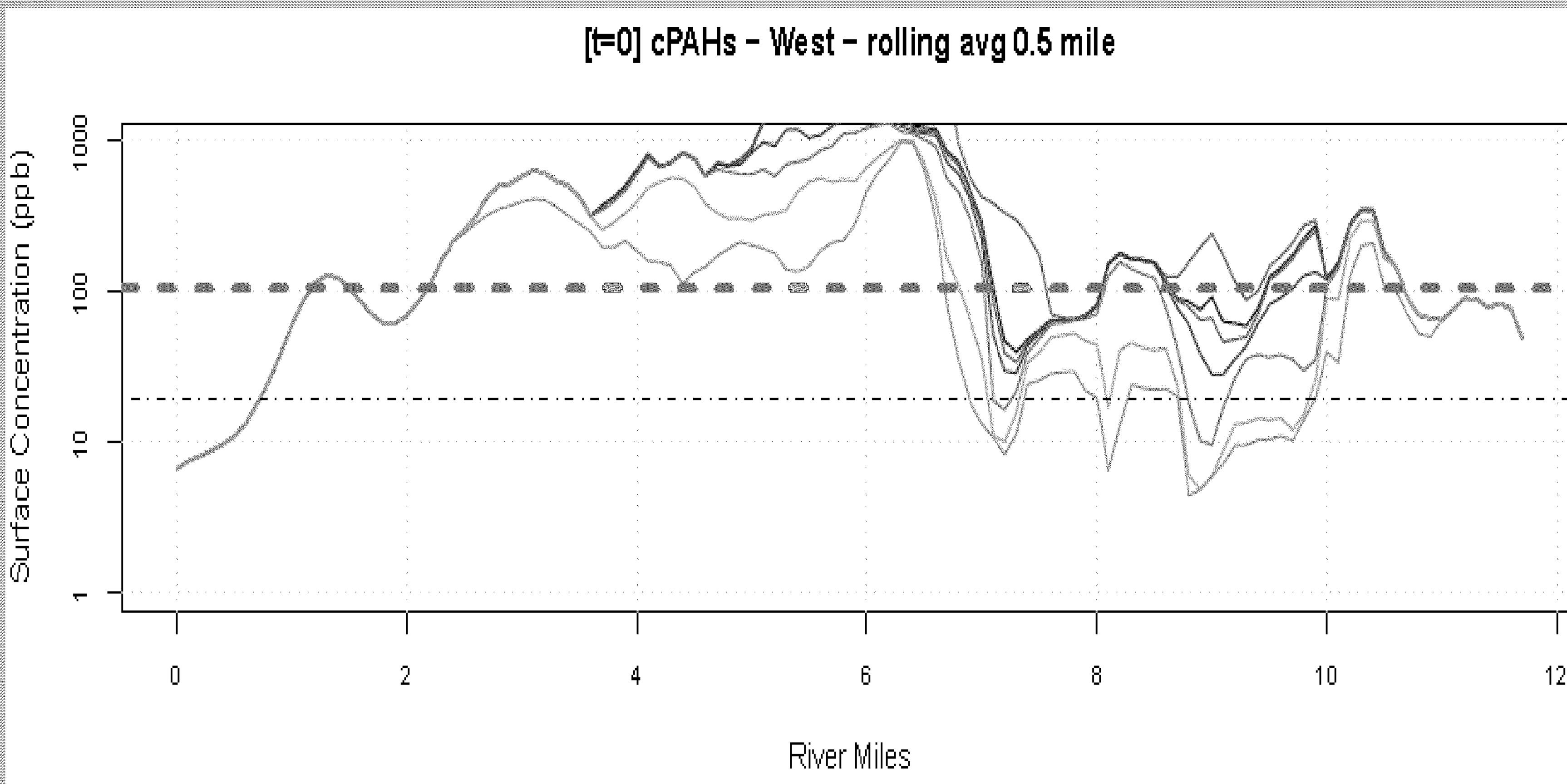
Receptors

- Human Direct Contact (nearshore only)

Size

- Rolling ½ RM in River Zones

Example Rolling 0.5 RM



1 River Mile

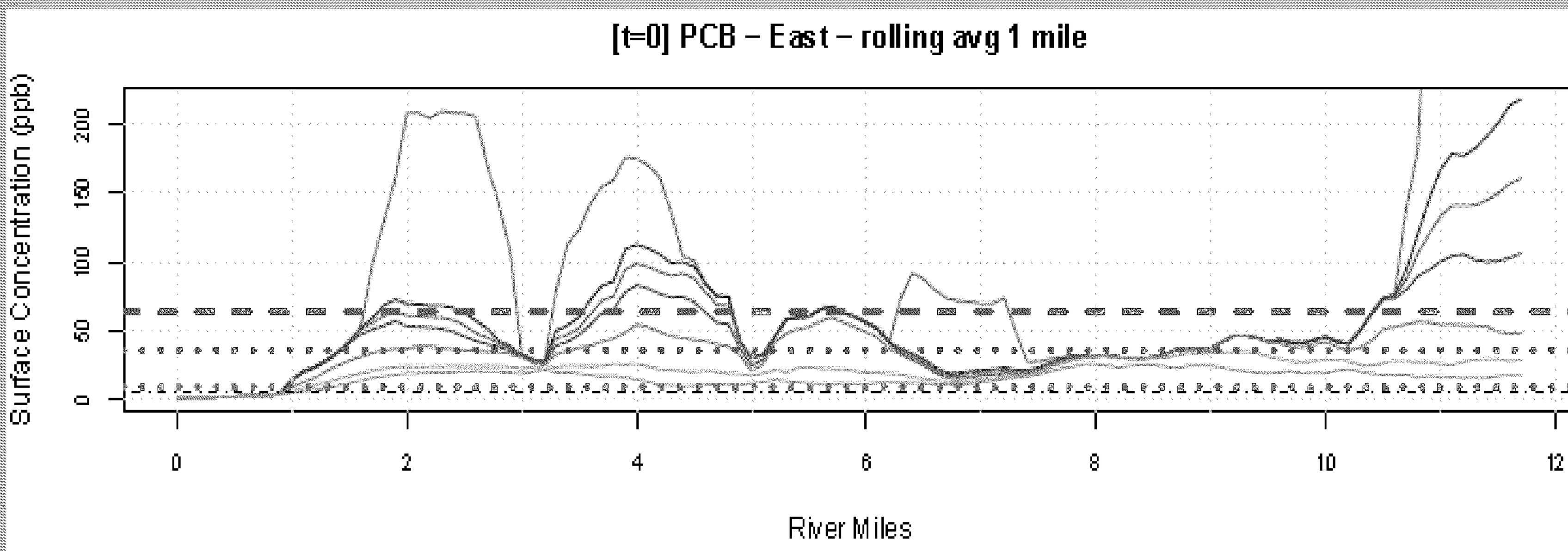
Receptors

* Recreational Fishers
* Smallmouth Bass
* Mink
* Osprey

Size

* Rolling RM in River Zones
* SDUs

Example Rolling 1 RM



Sediment Decision Units

Develop a spatial basis for evaluating remediation

- River Zones
- Centered on contaminant high concentration areas

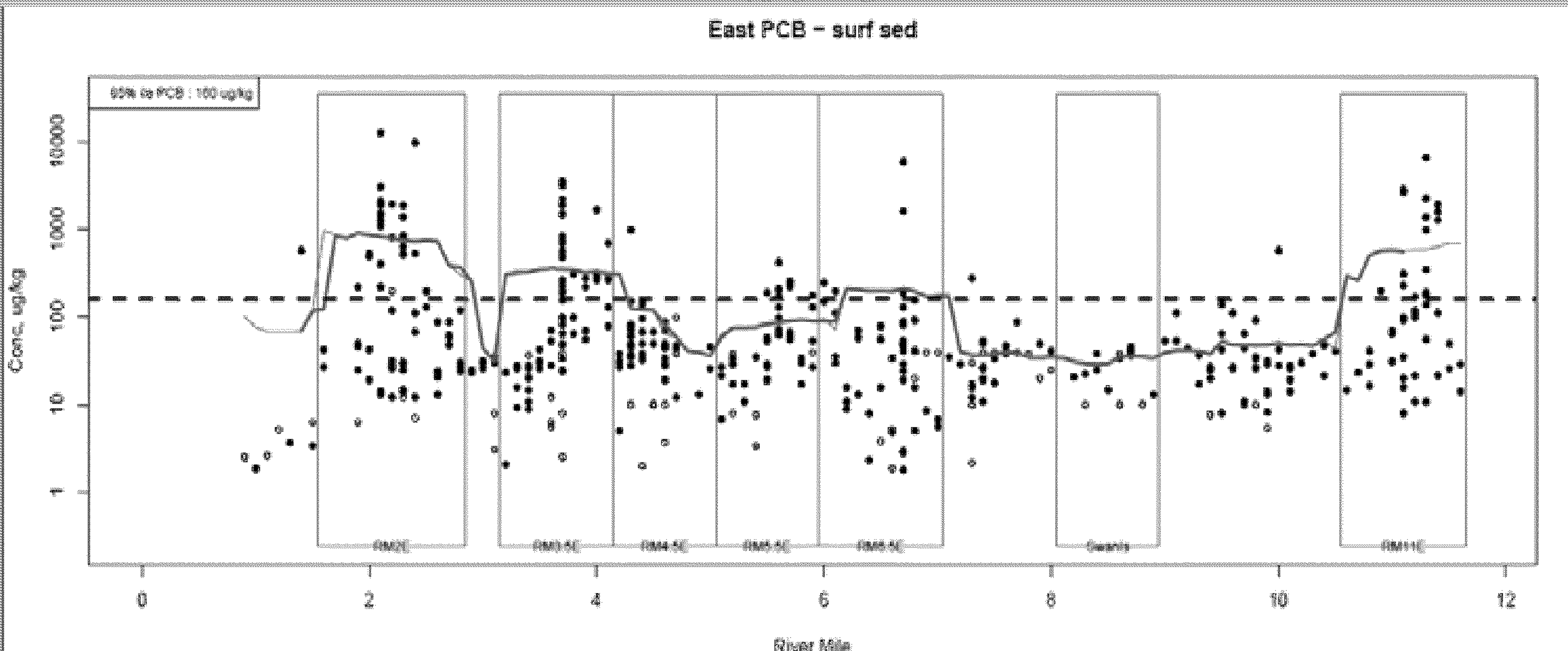
Goal

- Reproducibly defined, spatially based decision area
- Evaluate highest risk reduction

SDU Approach

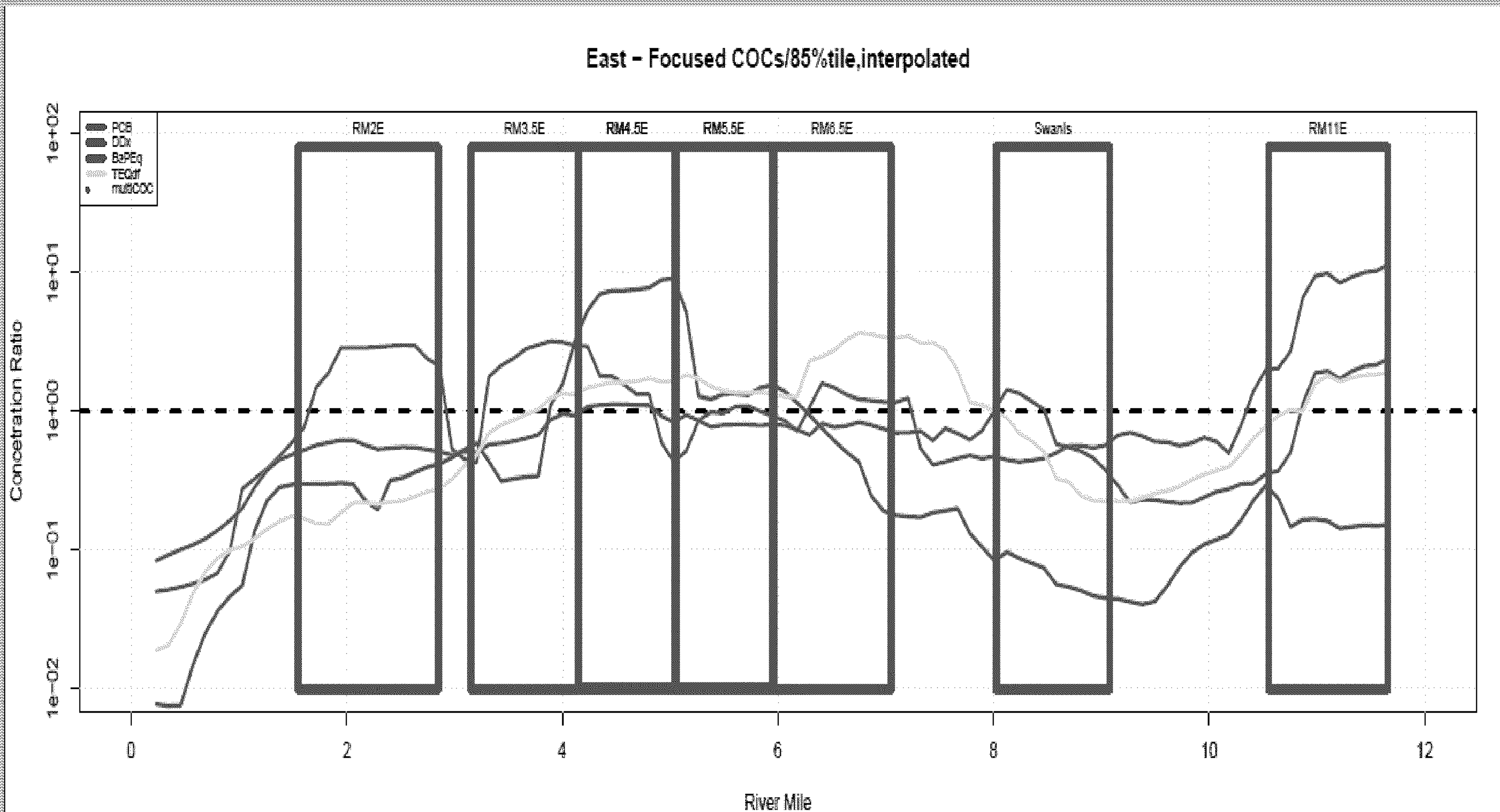
- Delineate areas of the site exhibiting the highest concentrations
- Segregate data based on river region
- Develop a rolling average based on non - weighted surface sediment results for the focused COCs
- Adjust SDU boundaries based on interpolated concentration contours
- Circle back to add additional SDUs based on other considerations (e.g., benthic risk, other COCs)

Example Rolling RM



Note: All SDUs shown, not just PCB related ones

Example 85% Normalization



Resulting SDU Evaluation Areas

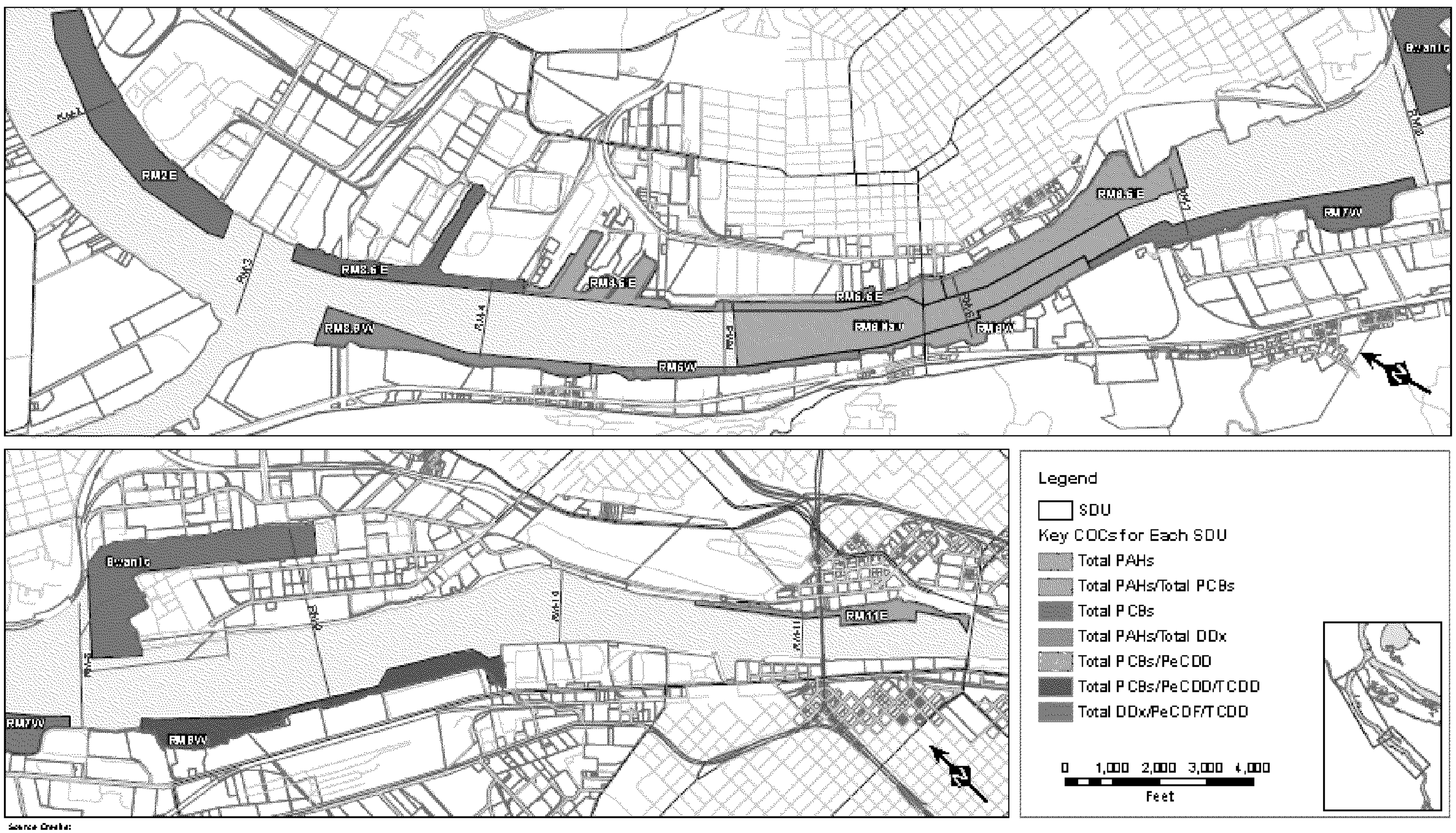


Figure 4.1-2. Sediment Decision Units and Key COCs

Draft, Deliberative, Do not cite or quote

Sediment Management Areas

- Dredging/capping technology applied
- Developed from technology assignments
- Delineated by high concentration contours
  - Remedial Action Levels

Portland Harbor

Cost

Major Point of Contention

* PRPs do not want costs underestimated for allocation
* PRPs want cost low
* Mitigation…cost too high
  * 14% capital costs – alt B
  * 58 acres – alt B
* Subtitle C
  * 45% capital costs – alt B
* Dredging unit costs (from LWG 2012)
  * $38.03/cy – open water
  * $53.66/cy - confined

Portland Harbor

Principal Threat Waste

Principal Threat Waste

- Source Material - NAPL
  - Chlorobenzene - Arkema
  - PAHs - Gasco

- Highly Toxic – exceeds 10^{-3}
  - PCBs > 200 µg/kg
  - cPAHs > 100,000 µg/kg
  - DDx > 7000 µg/kg
  - 2,3,7,8-TCDD > 0.02 µg/kg
  - 2,3,7,8-TCDF > 4 µg/kg
  - 1,2,3,7,8-PeCDD > 0.01 µg/kg
  - 2,3,4,7,8-PeCDF > 0.4 µg/kg
  - 1,2,3,4,6,7,8-HxCDF >0.3 µg/kg

PTW – Reliably Contained

Contaminant	PTW Contaminants Reliably Contained
Dioxins/Furans	Can be reliably contained
PAHs	Can be reliably contained
Chlorobenzene	<320 µg/kg
DDx	Can be reliably contained
Naphthalene	<140,000 µg/kg
PCBs	Can be reliably contained

Ex-situ Treatment Assumptions

- NAPL & PTW Not Reliably Contained
  - Chlorobenzene
  - Napthalene
  - PAHs - NAPL
  - DDx mixed with chlorobenzene
- Treatment Method
  - Thermal Desorption

Portland Harbor

Modeling MNR

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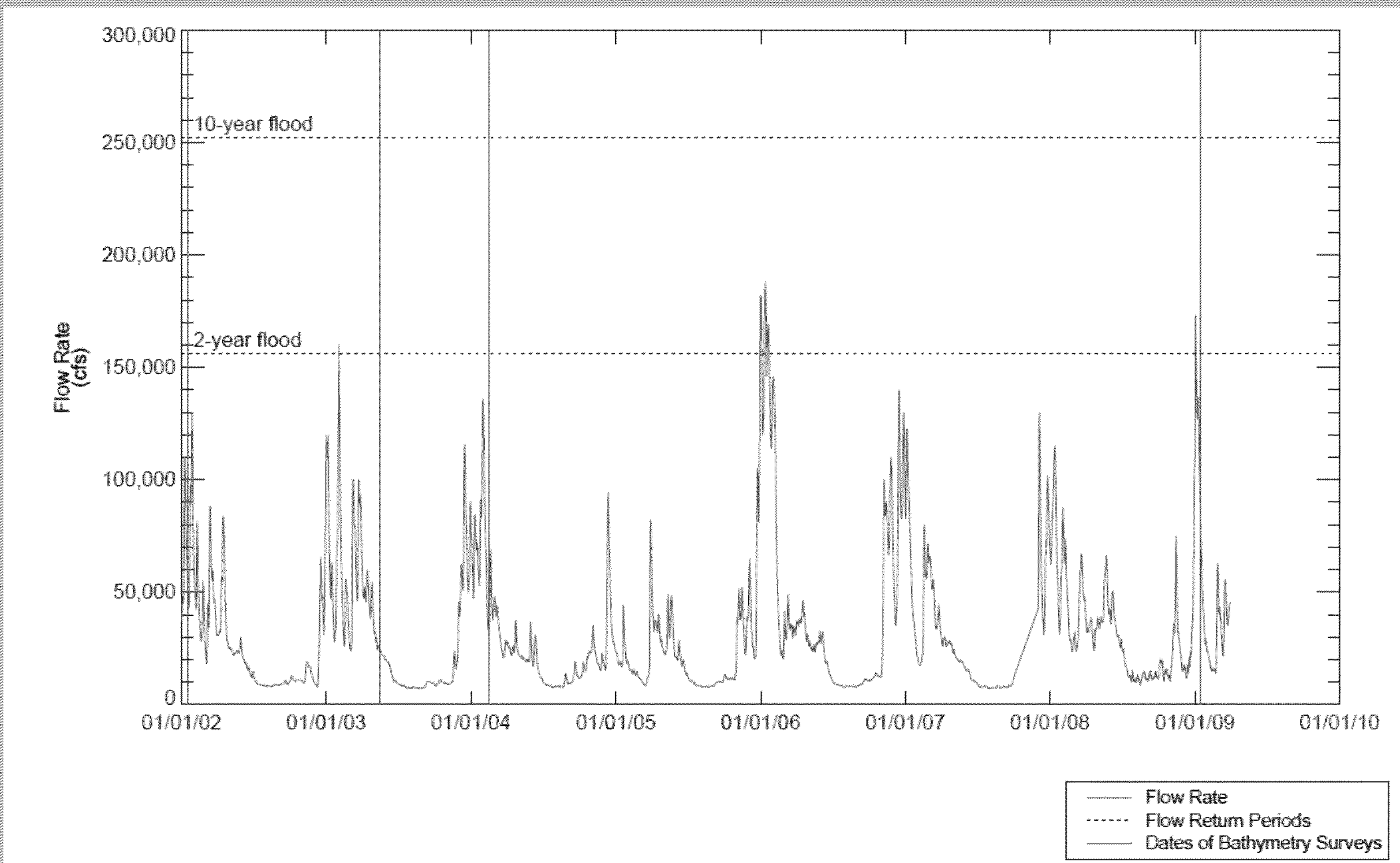
LWG hydrodynamic and sediment transport (HST) model

- Submitted in draft FS (2012)
- Used channel flow (EFDC) and channel sediment transport (SEDZLJ)
- Rejected by EPA
  - Models not coupled
  - Calibration was only for bathymetry, not chemistry
  - Complex system
    - Tidal fluctuations
    - Reverse flows
  - Did not account for bedload transport
  - Does not match CSM

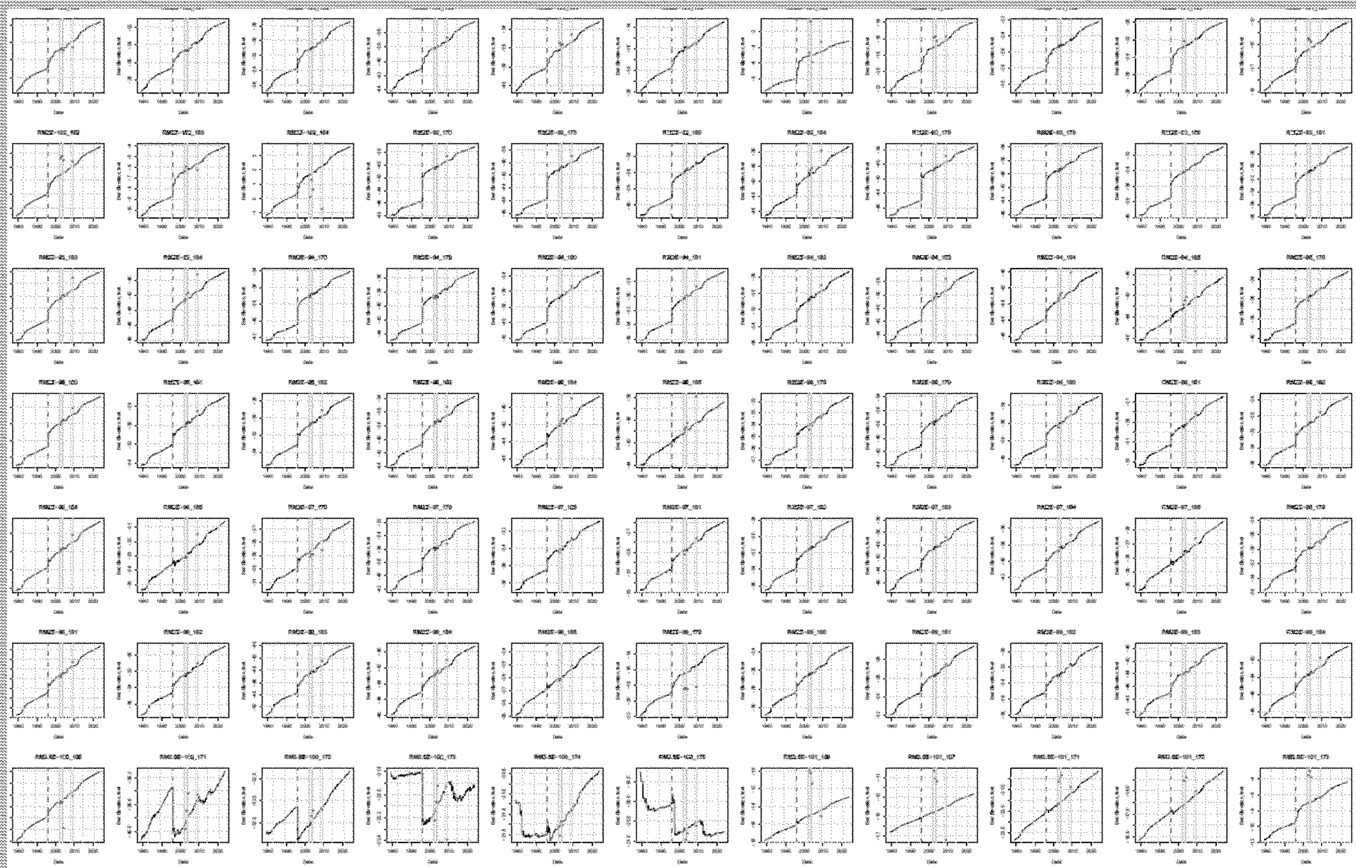
Model Grid Cells Example

Bathymetric Surveys



t>0 discussion

* LWG Model performance vs. Bathymetry graphs



Example of LWG Model Prediction

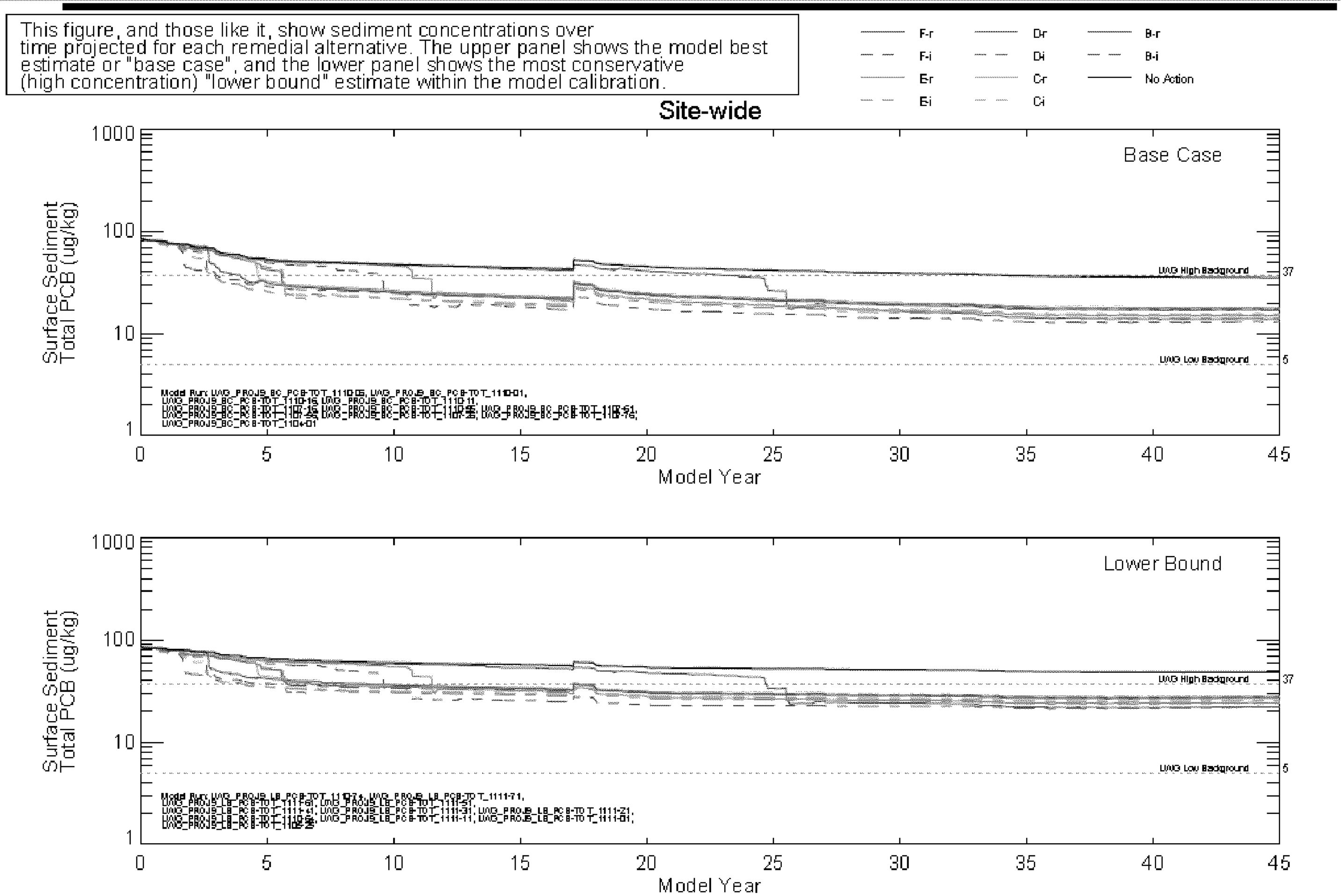


Figure 8.2.2-1

Portland Harbor RI/FS

Draft Feasibility Study

Simulation of FS Alternatives

Time Series of Surface Sediment (Top 1-ft) Total PCB Concentrations (Site-wide Average)

ANCHOR QEA

LWG Lower Willamette Group

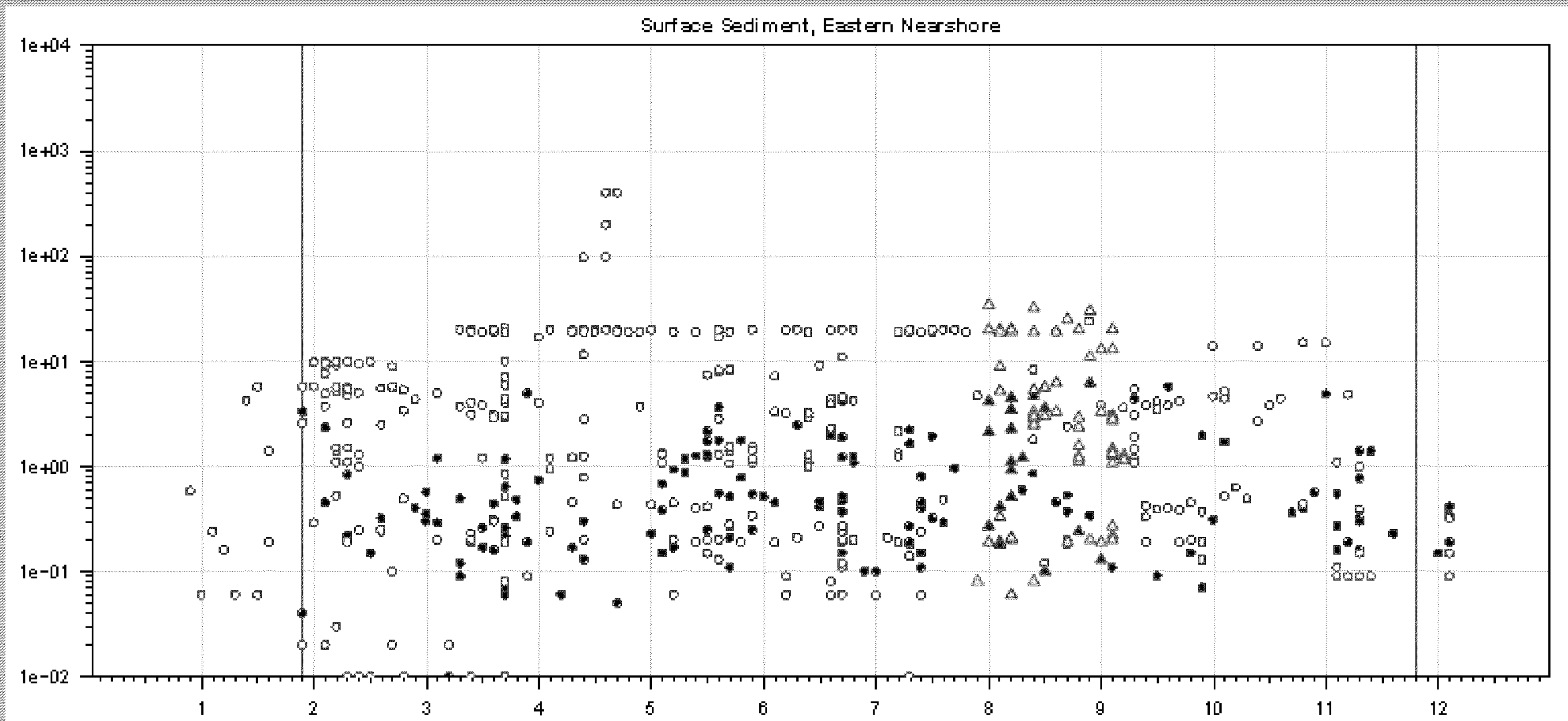
DO NOT QUOTE OR CITE
This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

Draft, Deliberative, Do not cite or quote

Portland Harbor

High-biasing Non-detects in Data Set

Example of High-biasing ND Hexachlorobenzene



EPA Contacts

Kristine Koch – Lead RPM

- (206) 553-6705
- koch.kristine@epa.gov

* Additional Information

http://www.epa.gov/region10/portlandharbor

To: Conley, Alanna[conley.alanna@epa.gov]
From: Christopher, Anne
Sent: Fri 10/16/2015 8:29:04 PM
Subject: RE: dredging narration (on or before next Friday-thanks)
TASC TO3 R10 TD1rev Portland Harbor DRAFT Short Dredging Slides_10-15-15 ac.pptx

Alanna,

Let me know if this is ok. I couldn't figure out how to stop recording/change slides, so you can hear some extra time with clicking at the end of each slide recording. Sorry about that! I can redo it if needed.

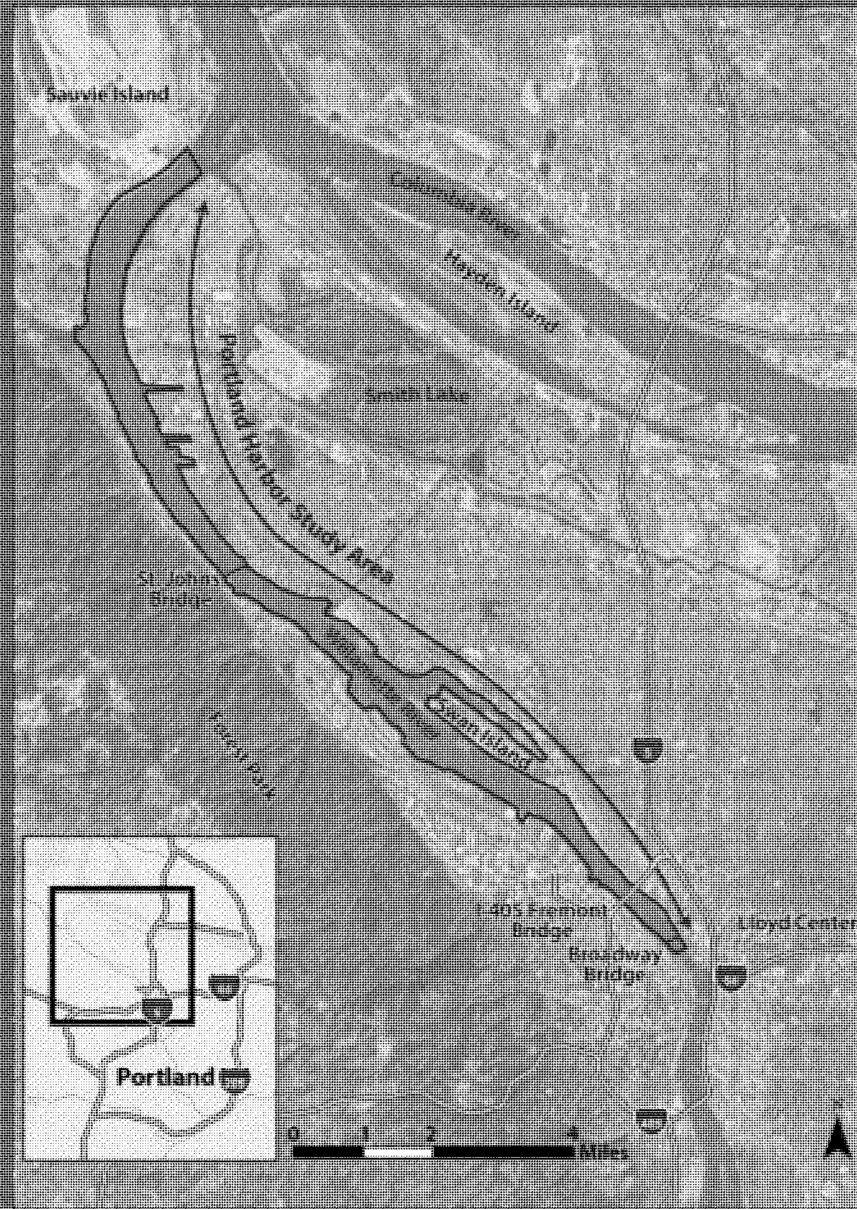
Annie

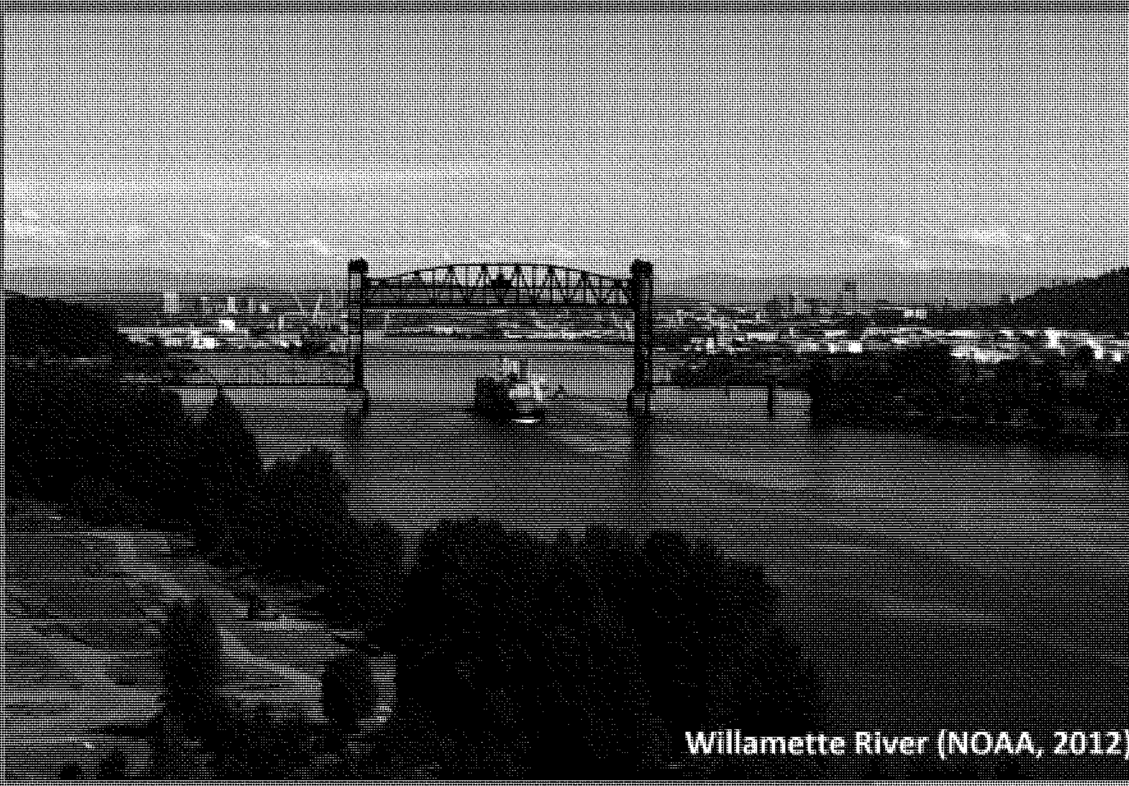
From: Conley, Alanna
Sent: Thursday, October 15, 2015 3:40 PM
To: Christopher, Anne
Subject: dredging narration (on or before next Friday-thanks)

United States Environmental Protection Agency

Portland Harbor Superfund Site

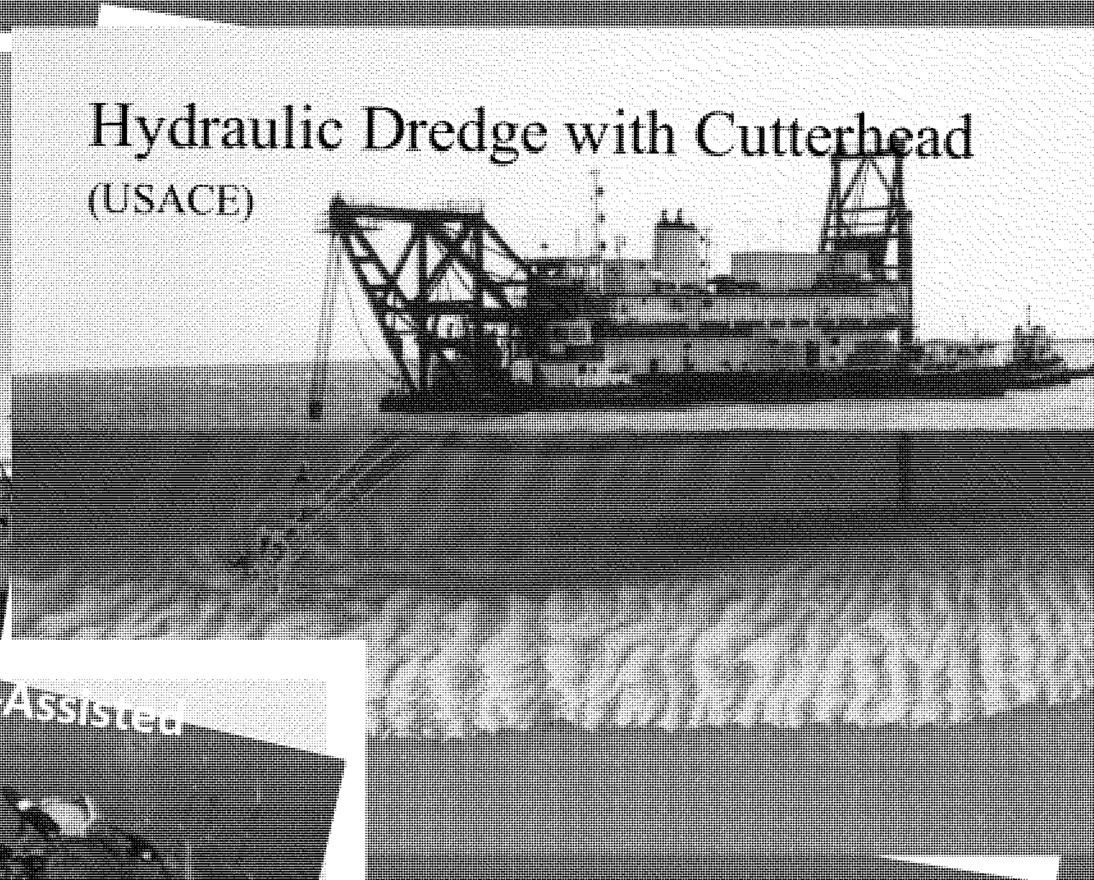
Dredging

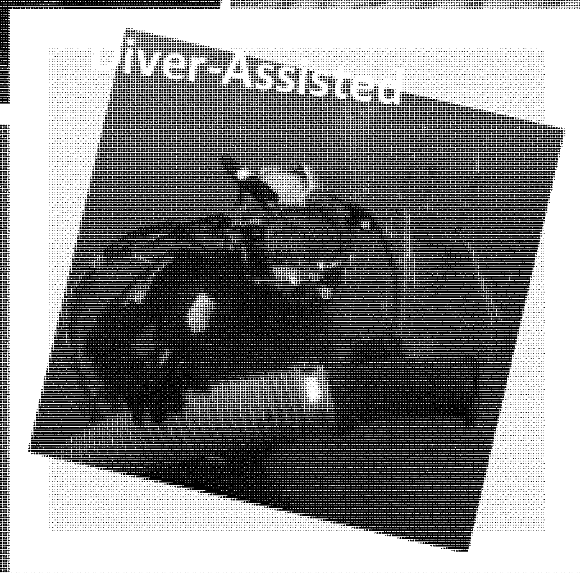



Willamette River (NOAA, 2012)


Dredge (USACE, 2012)


Mechanical Dredge (USACE)
WEEKS


Hydraulic Dredge with Cutterhead
(USACE)


Diver-Assisted

Advantages	Limitations
• Permanently removes contaminants	• Potential re-suspension of contaminated sediment
• Relatively fast process	• Difficult to reach very low cleanup goals
ercially available	• May still need cap
	• Can harm aquatic organisms
	• Handling and disposal of sediment may expose workers
	• Dewatering, treatment and


http://www.epa.gov/region10/portlandharbor
Capping
Monitored Natural Recovery
Monitoring

To: Lori Cora/R10/USEPA/US@EPA[]
From: "Christianson, Greg"
Sent: Fri 3/9/2012 7:28:55 PM
Subject: Portland Harbor
www.bingham.com

Lori,

On behalf of the signatories of the White Paper sent to EPA Region X in October 2011, we'd like to thank you, Kristine, Chip, Elizabeth and Burt for meeting with us on February 23, 2012 to share your PowerPoint presentation on Remedial Action Levels and Cleanup Alternatives for the Portland Harbor site and to answer our questions regarding the agency's ongoing remedy selection process. We appreciate that you took the time to respond to our concerns and questions. We now have a more complete understanding of EPA's ongoing remedy selection process and risk-related determinations.

As you know, the signatories raised serious concerns in our White Paper and again during the February 23 meeting regarding many aspects of the Portland Harbor RI/FS process. We have questioned key assumptions and scenarios from the human health and eco-risk assessments, including assumptions regarding fish and clam consumption. For example, we question assumptions in some scenarios that fish are regularly consumed whole and raw for an entire lifetime, with all fish consumed being a single species (i.e., small mouth bass) all caught within the limits of the site. We question EPA's use of the non-native clam consumption scenario to derive a PAH remediation goal because this scenario at best is implausible and because, as we learned through our meeting, EPA directed the use of the clam scenario as a "surrogate" for PAH impacts on fish, which we believe is inappropriate both as a technical matter and under EPA guidance. We also question certain ecological assumptions, e.g., that mink exclusively consume only a single species of fish, all taken from the river within the site with no fraction of their diet coming from birds or upland prey. As we discussed, in our view, certain of these risk scenarios and other EPA-mandated decisions are not merely conservative; they are unreasonable. As we noted at the February 23 meeting, we believe that using such scenarios to set Preliminary Remediation Goals (PRGs) that in turn serve as the basis for Remedial Action Levels (RALs) undermines the integrity of the risk assessment, feasibility study and risk management processes. We also remain concerned about the sequencing of these reports – with the studies on site risks being finalized after the draft FS is required to be submitted at the end of March.

We appreciate your willingness to engage in a spirited discussion on these topics where we disagree. During our discussion, you indicated that EPA's responses to many of our questions on the risk assessments will be provided in EPA's comments on the BHHRA (due in April 2012) and on the BERA (due in July 2012). We look forward to carefully reviewing your comments and any new data and other supporting materials and to engaging in further discussions with you. We were encouraged to hear that many of the key risk management decisions have not yet been made by EPA and that there is still time to review these assumptions and scenarios that will play a key role in the remedy selection. We understand that PRGs are not yet final and that the RALs being used to develop FS alternatives are subject to change. As parties with a stake in the site's future remediation, we have a strong desire to provide meaningful input on these issues before they are decided. We believe it is critically important that the risk management process properly weigh the weakness in some of the risk scenarios and the lack of support for certain of the underlying assumptions before they are finalized and relied upon for risk management decision-making. We look forward to continuing the dialogue with EPA on these important issues.

As you know, we have requested a meeting with EPA management to discuss policy issues regarding the remediation and would like to determine how we can ensure that we will have a meaningful role in future risk management decisions for the site. We would like to talk further with you or others at EPA as soon as possible about an appropriate means of ensuring that we are provided a meaningful opportunity for input in risk management decision-making. We also wish to share our thoughts with CSTAG and EPA managers who will be assessing the appropriateness of the remedy that is developed for this site and its consistency with work required at other sites. Since work is ongoing, it would be helpful to review a calendar of future events and to agree on specific points in time when the white paper signatories' input can be offered to EPA staff, and, at appropriate times, to CSTAG and EPA managers. Please let us know if it would be more appropriate to include the issue of our future role in our proposal for meeting with Region X senior management. To ensure that we have time to plan our schedule, we would appreciate it if you could reply on this point by March 20.

Thank you again for your frank discussion of these important topics and the open dialogue we have established to date.

Greg Christianson

BINGHAM
Greg Christianson | Bingham McCutchen LLP
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Los Angeles, CA 90071-3106
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www.bingham.com

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To: Cora.lori@epa.gov[]
Cc: []
From: CN=Chip Humphrey/OU=R10/O=USEPA/C=US
Sent: Tue 3/13/2012 8:59:40 PM
Subject: Fw: Portland Harbor
www.bingham.com

----- Forwarded by Chip Humphrey/R10/USEPA/US on 03/13/2012 01:59 PM -----

From: Lori Cora/R10/USEPA/US
To: Kristine Koch/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Cami Grandinetti/R10/USEPA/US@EPA, Dan Opalski/R10/USEPA/US@EPA, Lori Cohen/R10/USEPA/US@EPA
Date: 03/09/2012 12:38 PM
Subject: Fw: Portland Harbor

Not sure who all is in the management loop on Portland Harbor so am sending to all. Let me know how I should respond to their requests.

Lori Houck Cora | Assistant Regional Counsel
U.S. Environmental Protection Agency | Region 10
P: (206) 553.1115 | F: (206) 553.1762 | cora.lori@epa.gov

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----- Forwarded by Lori Cora/R10/USEPA/US on 03/09/2012 12:21 PM -----

From: "Christianson, Greg" <greg.christianson@bingham.com>
To: Lori Cora/R10/USEPA/US@EPA
Date: 03/09/2012 11:29 AM
Subject: Portland Harbor

Lori,

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Greg Christianson

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To: CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA;CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Mon 3/19/2012 8:29:18 PM
Subject: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)
FS Agenda 3-19-12.docx

All, Attached is the draft announcement and agenda for upcoming FS Public Information Sessions. Please provide your comments on Public Announcement by tomorrow. EPA, Oregon DEQ and LWG look to begin advertising this week.

During my last FS planning call, Krista Koehl switched hats and offered the Partnership's assistance in advertising/announcing the FS Public Information Sessions. I suggested that we decline her offer and only advertise the Public Sessions via EPA, ODEQ, LWG and CAG websites. Deb/Chip - if you agree, who should send email declining Partnerships offer to advertise? I don't mind doing since she mentioned during the call and coping you both. let me know.

Agenda attached - Draft final agenda that EPA, DWQ and LWG agreed on last week.

PUBLIC ANNOUNCEMENT

Public Information Sessions for Portland Harbor Feasibly Study (Please provide comments on announcement language below by tomorrow)
The Draft Feasibility Study for Portland Harbor is scheduled for release on March 30, 2012. The Feasibility Study (FS) is a comparison of clean-up options to manage contaminated soil and river sediment at Portland Harbor Superfund Site. A group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Study and will submit to the U.S. Environmental Protection Agency (U.S. EPA) for review. The FS is the second major deliverable in the Superfund process, after the remedial investigation (RI) that was submitted in 2009.
A series of Information Sessions will be offered to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed. The U.S. Environmental Protection Agency, Lower Willamette Group and Oregon Department of Environmental Quality (ODEQ) will host the Public Information Sessions.
Open house with light refreshments will be held directly before the Public Information Sessions. Representatives from U.S. EPA, LWG, ODEQ, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to meet you, talk with you and provide outreach materials on Portland Harbor.

1st Meeting, Wednesday, April 11, 2012

CAG Meeting
St John's Community Center
5:30 p.m. to 8:00 p.m.
8427 N. Central St.
The room is reserved and paid for.

2nd Meeting, Thursday, April 12, 2012
Portland Building Auditorium
12:30 p.m. to 3:00 p.m.
1120 SW 5th Avenue, 2nd Floor
This meeting will be taped

3rd Meeting, Wednesday, April 18, 2012
June Key Delta Community Center
5:30 p.m. to 8:00 p.m.
5940 N. Albina Street
The room is reserved and the paperwork has been submitted; waiting for finalization of EPA Insurance letter.

4th Meeting, Thursday, May 10, 2012
Ecotrust - Billy Frank Jr. Conference Center
5:30 p.m. to 8:00 p.m.
721 NW Ninth Avenue
Contract being completed by LWG

ED_000959_NSF_00004241-00002 01/24/2020 SEMS_0333959

Public Informational Session on the Portland Harbor Draft Feasibility Study

Sponsored by: U.S. Environmental Protection Agency (U.S. EPA), Lower Willamette Group (LWG) and Oregon Department of Environmental Quality (ODEQ)

Wednesday, April 11, 2012; 5:30 pm to 8 pm
St John's Community Center, 8427 N Central St, Portland, OR 97203

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — U.S. EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up

8pm Adjourn

Light refreshments provided during Open House. Representatives from U.S. EPA, LWG, ODEQ, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

Public Informational Session on the Portland Harbor Draft Feasibility Study

Sponsored by: U.S. Environmental Protection Agency (U.S. EPA), Lower Willamette Group (LWG) and Oregon Department of Environmental Quality (ODEQ)

Thursday, April, 12, 2012; 12:30 pm to 3:00 pm
Portland Building Auditorium, 1120 SW 5th Avenue, 2nd Floor, Portland, Oregon 97204

12:30 pm Open house*

1:00 Welcome, Meeting Purpose & Agenda review

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

1:10 Burning Questions from the Audience

1:20 Background & Discussion of Portland Harbor Project — U.S. EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

1:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

2:20 Future steps in cleanup process after Draft Feasibility Study — U.S. EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

2:25 Question review

2:55 Wrap-up

3pm Adjourn

Light refreshments provided during Open House. Representatives from U.S. EPA, LWG, ODEQ, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

Public Informational Session on the Portland Harbor Draft Feasibility Study

Sponsored by: U.S. Environmental Protection Agency (U.S. EPA), Lower Willamette Group (LWG) and Oregon Department of Environmental Quality (ODEQ)

Wednesday, April 18, 2012; 5:30 pm – 8 pm
June Key Delta Community Center, 5940 N. Albina Street, Portland, OR 97217

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — U.S. EPA and ODEQ

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- Why should I be concerned about Portland Harbor site?

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- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

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- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up

8pm Adjourn

Light refreshments provided during Open House. Representatives from U.S. EPA, LWG, ODEQ, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

Public Informational Session on the Portland Harbor Draft Feasibility Study

Sponsored by: U.S. Environmental Protection Agency (U.S. EPA), Lower Willamette Group (LWG) and Oregon Department of Environmental Quality (ODEQ)

Thursday, May, 10, 2012; 5:30 pm – 8 pm
Ecotrust Building, 721 Northwest 9th Avenue, Suite 200, Portland, OR 97209

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — U.S. EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up

8pm Adjourn

Light refreshments provided during Open House. Representatives from U.S. EPA, LWG, ODEQ, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

INTERNAL COPY: This is a draft for planning and discussion purposes only.

Public Informational Session on the Portland Harbor Draft Feasibility Study

Sponsored by: U.S. Environmental Protection Agency (U.S. EPA) Oregon Department of Environmental Quality (ODEQ) and Lower Willamette Group (LWG)
Information Session: 6:00 pm to 8:00 pm

5:30pm Open house* Refreshments and booths for information display and Public interaction (EPA, LWG, ODEQ, Tribes, Trustees, CAG) **(Facilitator walks the room and captures questions/concerns of public)**

6:00 Welcome, Meeting Purpose & Agenda review — Facilitator

(Discuss Ground rules & clearly state the meeting purpose to help manage expectations)

Welcome: Acknowledge attendees, public figures, Tribes, Trustees, CAG (3min)
Purpose: (5min)

- Explain the cleanup alternatives presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan and opportunities for public input
- Discuss opportunities for Public involvement

Agenda Review and Introduction of presenters (2min)

6:10 Burning Questions from the Audience **– (Capture on Flip Chart, note more time for Q&A on agenda)**

6:20 Background & Discussion of Risk — EPA/ODEQ

DRAFT

(Adjust time/content depending on audience & initial questions)

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study — LWG

(Adjust discussion time depending on audience & initial questions)

- Overview: What will FS tell me? How will it be used? Who wrote it? Who paid for it?
- Detailed examples of clean-up options for Portland Harbor
- How the analysis was done
- Questions? (15min) (Facilitated to capture on flip chart for Q&A)

7:20 Future steps in cleanup process after Draft FS (Diagram next steps) (5min) — EPA

- Developing Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comment

7:25 Review flip chart questions **(Time should be adjusted to ensure response to all questions)** — Facilitator

7:55 Wrap-up — Facilitator

8pm Adjourn (time adjusted to ensure response to questions)

To: CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Tue 3/20/2012 12:03:17 AM
Subject: Re: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)
FS Agenda 3-19-12.docx

Wenona- good idea. Revisions below. Thanks for catching that.

Announcement Revision: "The U.S. EPA will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed. "

The revised agenda: "Sponsored by" was removed. Only list agency names followed by acronyms.
"Public Informational Session on the Portland Harbor Draft Feasibility Study
U.S. Environmental Protection Agency (U.S. EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)"

From: Wenona Wilson/R10/USEPA/US
To: Alanna Conley/R10/USEPA/US@EPA
Cc: Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 03/19/2012 04:35 PM
Subject: Re: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)

Hi Alanna,

In at least two separate places we reference the meetings are co-hosted or co-sponsored by the LWG. I am newer to this Site but it seems to me we should not be co-hosting or co-sponsoring meetings with a PRP group. There needs to be a greater separation. I understand the PRP group will present the FS and that they are paying for the room but I would prefer these meetings are referenced as EPA meetings or EPA -State meetings. Public needs to trust these are public meetings organized by the government.

Let me know if I am missing something.

And I agree we should not take the Partnership up on their offer to help us advertise. Same reasons - confusing to the public.

Thanks -

Wenona Wilson, Manager

Ecosystem & Community Health Unit
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900 (ETPA-086)
Seattle, WA 98101-3140
Phone (206) 553-2148; Fax (206) 553-6984

From: Alanna Conley/R10/USEPA/US
To: Wenona Wilson/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 03/19/2012 01:29 PM
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The U.S. EPA will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed.
Open house with light refreshments will be held directly before the Public Information Sessions. Representatives from U.S. EPA, LWG, ODEQ, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to meet you and provide outreach materials on Portland Harbor.

1st Meeting, Wednesday, April 11, 2012
CAG Meeting
St John's Community Center
5:30 p.m. to 8:00 p.m.

8427 N. Central St.
The room is reserved and paid for.

2nd Meeting, Thursday, April 12, 2012
Portland Building Auditorium
12:30 p.m. to 3:00 p.m.
1120 SW 5th Avenue, 2nd Floor
This meeting will be taped

3rd Meeting, Wednesday, April 18, 2012
June Key Delta Community Center
5:30 p.m. to 8:00 p.m.
5940 N. Albina Street
The room is reserved and the paperwork has been submitted; waiting for finalization of EPA Insurance letter.

4th Meeting, Thursday, May 10, 2012
Ecotrust - Billy Frank Jr. Conference Center
5:30 p.m. to 8:00 p.m.
721 NW Ninth Avenue
Contract being completed by LWG

To: CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Tue 3/20/2012 12:43:11 AM
Subject: Revised : FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)
FS Agenda 3-19-12.docx

Announcement Revision: "Under the direction of United States Environmental Protection Agency (EPA), a group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Feasibility Study." "The United States Environmental Protection Agency will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed. "

The revised agenda: "Sponsored by" was removed. Only list agency names followed by acronyms.
"Public Informational Session on the Portland Harbor Draft Feasibility Study
United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)"

From: Wenona Wilson/R10/USEPA/US
To: Alanna Conley/R10/USEPA/US@EPA
Cc: Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 03/19/2012 04:35 PM
Subject: Re: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)

Hi Alanna,

In at least two separate places we reference the meetings are co-hosted or co-sponsored by the LWG. I am newer to this Site but it seems to me we should not be co-hosting or co-sponsoring meetings with a PRP group. There needs to be a greater separation. I understand the PRP group will present the FS and that they are paying for the room but I would prefer these meetings are referenced as EPA meetings or EPA -State meetings. Public needs to trust these are public meetings organized by the government.

Let me know if I am missing something.

And I agree we should not take the Partnership up on their offer to help us advertise. Same reasons - confusing to the public.

Thanks -

Wenona Wilson, Manager
Ecosystem & Community Health Unit
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900 (ETPA-086)
Seattle, WA 98101-3140
Phone (206) 553-2148; Fax (206) 553-6984

From: Alanna Conley/R10/USEPA/US
To: Wenona Wilson/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 03/19/2012 01:29 PM
Subject: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)

All, Attached is the draft announcement and agenda for upcoming FS Public Information Sessions. Please provide your comments on Public Announcement by tomorrow. EPA, Oregon DEQ and LWG look to begin advertising this week.

During my last FS planning call, Krista Koehl switched hats and offered the Partnership's assistance in advertising/announcing the FS Public Information Sessions. I suggested that we decline her offer and only advertise the Public Sessions via EPA, ODEQ, LWG and CAG websites. Deb/Chip - if you agree, who should send email declining Partnerships offer to advertise? I don't mind doing since she mentioned during the call and coping you both. let me know.

Agenda attached - Draft final agenda that EPA, DWQ and LWG agreed on last week.

PUBLIC ANNOUNCEMENT

Public Information Sessions for Portland Harbor Feasibly Study (Please provide comments on announcement language below by tomorrow)
The Draft Feasibility Study for Portland Harbor is scheduled for release on March 30, 2012. The Feasibility Study (FS) is a comparison of clean-up options to manage contaminated soil and river sediment at Portland Harbor Superfund Site. Under the direction of United States Environmental Protection Agency (EPA), a group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Feasibility Study. The Study will be submitted to the United States Environmental Protection Agency for review. The Feasibility Study is the second major deliverable in the Superfund process, after the remedial investigation that was submitted in 2009.
The United States Environmental Protection Agency will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed.
Open house with light refreshments will be held directly before the Public Information Sessions. Representatives from United States Environmental Protection Agency, Lower Willamette Group, Oregon Department of Environmental Quality, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to talk with you about the Portland Harbor Superfund site.

1st Meeting, Wednesday, April 11, 2012

CAG Meeting
St John's Community Center
5:30 p.m. to 8:00 p.m.
8427 N. Central St.

2nd Meeting, Thursday, April 12, 2012
Portland Building Auditorium
12:30 p.m. to 3:00 p.m.
1120 SW 5th Avenue, 2nd Floor

3rd Meeting, Wednesday, April 18, 2012
June Key Delta Community Center
5:30 p.m. to 8:00 p.m.
5940 N. Albina Street

4th Meeting, Thursday, May 10, 2012
Ecotrust - Billy Frank Jr. Conference Center
5:30 p.m. to 8:00 p.m.
721 NW Ninth Avenue

ED_000959_NSF_00004246-00003 01/24/2020 SEMS_0333962

Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Wednesday, April 11, 2012; 5:30 pm to 8 pm
St John's Community Center, 8427 N Central St, Portland, OR 97203

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review — EPA

7:55 Wrap-up — EPA

8pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Thursday, April, 12, 2012; 12:30 pm to 3:00 pm
Portland Building Auditorium, 1120 SW 5th Avenue, 2nd Floor, Portland, Oregon 97204

Time	Item	Presenter
12:30 pm	Open house*	
1:00	Welcome, Meeting Purpose & Agenda review Purpose: ▪ Explain the cleanup options presented in the Draft Feasibility Study ▪ Provide time for clarification and questions ▪ Clarify EPAs role in determining the final cleanup plan ▪ Discuss opportunities for Public Involvement	EPA
1:10	Burning Questions from the Audience	
1:20	Background & Discussion of Portland Harbor Project ▪ Background of Portland Harbor Superfund Site ▪ Where are we in the process? What have we learned? ▪ Discussion of source control ▪ Why should I be concerned about Portland Harbor site?	EPA and ODEQ
1:45	Draft Feasibility Study (FS) ▪ Overview: What will FS tell me? How will it be used? ▪ Examples and description of clean-up options for Portland Harbor	LWG
2:20	Future steps in cleanup process after Draft Feasibility Study ▪ Develop Proposed Plan & Record of Decision ▪ Opportunities for public involvement, information and comments	EPA
2:25	Question review	
2:55	Wrap-up	EPA
3pm	Adjourn	

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

ED_000959_NSF_00004247-00002 01/24/2020 SEMS_0333963

Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Wednesday, April 18, 2012; 5:30 pm – 8 pm
June Key Delta Community Center, 5940 N. Albina Street, Portland, OR 97217

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:
- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ
- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study (FS) — LWG
- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA
- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up — EPA

8pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Thursday, May, 10, 2012; 5:30 pm – 8 pm
Ecotrust Building, 721 Northwest 9th Avenue, Suite 200, Portland, OR 97209

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

DRAFT

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up — EPA

8pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.*

<u>INTERNAL COPY: This is a draft for planning and discussion purposes only.</u>

Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Information Session: 6:00 pm to 8:00 pm

5:30pm Open house* Refreshments and booths for information display and Public interaction (EPA, LWG, ODEQ, Tribes, Trustees, CAG) **(Facilitator walks the room and captures questions/concerns of public)**

6:00 Welcome, Meeting Purpose & Agenda review — EPA, Facilitator
(Discuss Ground rules & clearly state the meeting purpose to help manage expectations)

Welcome: Acknowledge attendees, public figures, Tribes, Trustees, CAG (3min)
Purpose: (5min)
- Explain the cleanup alternatives presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan and opportunities for public input
- Discuss opportunities for Public involvement

Agenda Review and Introduction of presenters (2min)

6:10 Burning Questions from the Audience **– (Capture on Flip Chart, note more time for Q&A on agenda)**

DRAFT

6:20 Background & Discussion of Risk — EPA/ODEQ
(Adjust time/content depending on audience & initial questions)
- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

6:45 Draft Feasibility Study — LWG
(Adjust discussion time depending on audience & initial questions)
- Overview: What will FS tell me? How will it be used? Who wrote it? Who paid for it?
- Detailed examples of clean-up options for Portland Harbor
- How the analysis was done
- Questions? (15min) (Facilitated to capture on flip chart for Q&A)

7:20 Future steps in cleanup process after Draft FS (Diagram next steps) (5min) — EPA
- Developing Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comment

7:25 Review flip chart questions **(Time should be adjusted to ensure response to all questions)** — Facilitator

7:55 Wrap-up — EPA

8pm Adjourn (time adjusted to ensure response to questions)

To: Barbara Smith [barbara@harrisandsmith.com]; nn Beier [ann.beier@portlandoregon.gov]; laire Levine [c3l@nwnatural.com]; harlie Burr [Charlie.Burr@edelman.com]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;David Harvey [david.harvey@gbrx.com]; avid Harvey [david.harvey@gbrx.com]; iane Mayse [diane@harrisandsmith.com]; Jim McKenna " [jim.mckenna@verdantllc.com]; ennifer Woronets [jworonets@anchorqea.com]; im Heiting [kah@nwnatural.com]; elly Madalinski [Kelly.Madalinski@portofportland.com]; im.Cox@portlandoregon.gov;Krista.Koehl@portofportland.com;MCatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; rista.Koehl@portofportland.com;MCatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; CatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; usan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; nderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; ANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; halen.dan@epa.gov;pldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; ldefur@igc.org;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; Ebbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; Peers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; obert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; ose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; rin.madden@gmail.com;Lauren.Senkyr@noaa.gov[]; auren.Senkyr@noaa.gov[]
Cc: []
Bcc: CN=Lori Cora/OU=R10/O=USEPA/C=US[]
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Fri 3/23/2012 6:17:57 PM
Subject: Fw: March 28 call and Draft FS Information Session Announcement - (NOT FOR RELEASE)
Outreach Call Minutes from 3-13-12.docx
US EPA Public Information Sessions for Portland Harbor Draft Feasibility Study.docx

Next FS Planning Meeting: Wednesday, March 28, 2-3pm, Dial-In Number, Personal Privacy / Ex. 6 and Conference Code, Personal Privacy / Ex. 6 call in only, we will not meet in the Portland Office)

Agenda:

Public announcement - Finalize and announce on Wednesday after meeting.
Meeting logistics and PA system
Other points to consider?

March 13 Meeting minutes (Thank you to Diane)

DO NOT RELEASE - DRAFT PUBLIC ANNOUNCEMENT (NOT FOR RELEASE):
Public Information Sessions for Portland Harbor Feasibly Study

The draft Feasibility Study (FS) Report is expected to be submitted to the United States Environmental Protection Agency (EPA) for review on March 30, 2012. The Study will be made available for public review shortly after. The Feasibility Study (FS) is a comparison of clean-up options to manage contaminated soil and river sediment at Portland Harbor Superfund Site. Under the direction of United States Environmental Protection Agency, a group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Feasibility Study.

The United States Environmental Protection Agency will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, next steps for making decisions about the cleanup, and opportunities for public involvement will also be discussed.

Open house, with light refreshments provided by the Lower Willamette Group, will be held directly before the Public Information Sessions. Representatives from United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to talk with the public.

1st Meeting, Wednesday, April 11, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
St John's Community Center, 8427 N. Central St., Portland, Oregon

2nd Meeting, Thursday, April 12, 2012, 1 p.m. to 3:00 p.m. (Open House 12:30 to1 p.m.)
Portland Building Auditorium, 1120 SW 5th Avenue, 2nd Floor, Portland, Oregon

3rd Meeting, Wednesday, April 18, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
June Key Delta Community Center, 5940 N. Albina Street, Portland, Oregon

4th Meeting, Thursday, May 10, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
Ecotrust Building- Billy Frank Jr. Conference Center, 721 NW Ninth Avenue, Portland, Oregon

(See attached file: Outreach Call Minutes from 3-13-12.docx)

To: CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]
Cc: AEbbets@stratusconsulting.com;anderson.jim@deq.state.or.us;Ann Beier [ann.beier@portlandoregon.gov]; nderson.jim@deq.state.or.us;Ann Beier [ann.beier@portlandoregon.gov]; nn Beier [ann.beier@portlandoregon.gov]; arbara Smith [barbara@harrisandsmith.com]; laire Levine [c3l@nwnatural.com]; harlie Burr [Charlie.Burr@edelman.com]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;DANAB.Marcia@deq.state.or.us;David Harvey [david.harvey@gbrx.com]; ANAB.Marcia@deq.state.or.us;David Harvey [david.harvey@gbrx.com]; avid Harvey [david.harvey@gbrx.com]; iane Mayse [diane@harrisandsmith.com]; rin.madden@gmail.com;"Jim McKenna " [jim.mckenna@verdantllc.com]; Jim McKenna " [jim.mckenna@verdantllc.com]; Peers@stratusconsulting.com;Jennifer Woronets [jworonets@anchorqea.com]; ennifer Woronets [jworonets@anchorqea.com]; im Heiting [kah@nwnatural.com]; elly Madalinski [Kelly.Madalinski@portofportland.com]; im.Cox@portlandoregon.gov;Krista.Koehl@portofportland.com;Lauren.Senkyr@noaa.gov;MCatedralKing@chevron.com;phalen.dan@epa.gov;pldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; rista.Koehl@portofportland.com;Lauren.Senkyr@noaa.gov;MCatedralKing@chevron.com;phalen.dan@epa.gov;pldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; auren.Senkyr@noaa.gov;MCatedralKing@chevron.com;phalen.dan@epa.gov;pldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; CatedralKing@chevron.com;phalen.dan@epa.gov;pldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; halen.dan@epa.gov;pldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; ldefur@igc.org;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; obert.neely@noaa.gov;rose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; ose@yakamafish-nsn.gov;Susan.Wilson@gbrx.com[]; usan.Wilson@gbrx.com[]
Bcc: CN=Lori Cora/OU=R10/O=USEPA/C=US[]
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Fri 3/23/2012 6:26:10 PM
Subject: Use this version with attachments: Fw: March 28 call and Draft FS Information Session Announcement - (NOT FOR RELEASE)
Outreach Call Minutes from 3-13-12.docx
US EPA Public Information Sessions for Portland Harbor Draft Feasibility Study (4).docx

Please use this version with attachment. Disregard previously sent email.

-----Alanna Conley/R10/USEPA/US wrote: -----
To: Barbara Smith <barbara@harrisandsmith.com>, Ann Beier <ann.beier@portlandoregon.gov>, Claire Levine <c3l@nwnatural.com>, Charlie Burr <Charlie.Burr@edelman.com>, Chip Humphrey/R10/USEPA/US@EPA, David Harvey <david.harvey@gbrx.com>, Diane Mayse <diane@harrisandsmith.com>, "Jim McKenna " <jim.mckenna@verdantllc.com>, Jennifer Woronets <jworonets@anchorqea.com>, Kim Heiting <kah@nwnatural.com>, Kelly Madalinski <Kelly.Madalinski@portofportland.com>, Kim.Cox@portlandoregon.gov, Krista.Koehl@portofportland.com, MCatedralKing@chevron.com, Susan.Wilson@gbrx.com, anderson.jim@deq.state.or.us, DANAB.Marcia@deq.state.or.us, phalen.dan@epa.gov, pldefur@igc.org, AEbbets@stratusconsulting.com, JPeers@stratusconsulting.com, robert.neely@noaa.gov, rose@yakamafish-nsn.gov, erin.madden@gmail.com, Lauren.Senkyr@noaa.gov
From: Alanna Conley/R10/USEPA/US
Date: 03/23/2012 11:17AM
Subject: Fw: March 28 call and Draft FS Information Session Announcement - (NOT FOR RELEASE)

(See attached file: US EPA Public Information Sessions for Portland Harbor Draft Feasibility Study.docx)

Next FS Planning Meeting: Wednesday, March 28, 2-3pm, Dial-In Number, Personal Privacy / Ex. 6 and Conference Code, Personal Privacy / Ex. 6 call in only, we will not meet in the Portland Office)

Agenda:
Public announcement - Finalize and announce on Wednesday after meeting.
Meeting logistics and PA system
Other points to consider?

March 13 Meeting minutes (Thank you to Diane)

DO NOT RELEASE - DRAFT PUBLIC ANNOUNCEMENT (NOT FOR RELEASE):
Public Information Sessions for Portland Harbor Feasibly Study

The draft Feasibility Study (FS) Report is expected to be submitted to the United States Environmental Protection Agency (EPA) for review on March 30, 2012. The Study will be made available for public review shortly after. The Feasibility Study (FS) is a comparison of clean-up options to manage contaminated soil and river sediment at Portland Harbor Superfund Site. Under the direction of United States Environmental Protection Agency, a group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Feasibility Study.

The United States Environmental Protection Agency will hold a series of Information Sessions to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, next steps for making decisions about the cleanup, and opportunities for public involvement will also be discussed.

Open house, with light refreshments provided by the Lower Willamette Group, will be held directly before the Public Information Sessions. Representatives from United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to talk with the public.

1st Meeting, Wednesday, April 11, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
St John's Community Center, 8427 N. Central St., Portland, Oregon

2nd Meeting, Thursday, April 12, 2012, 1 p.m. to 3:00 p.m. (Open House 12:30 to1 p.m.)
Portland Building Auditorium, 1120 SW 5th Avenue, 2nd Floor, Portland, Oregon

3rd Meeting, Wednesday, April 18, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
June Key Delta Community Center, 5940 N. Albina Street, Portland, Oregon

4th Meeting, Thursday, May 10, 2012, 6 p.m. to 8:00 p.m. (Open House 5:30 to 6 p.m.)
Ecotrust Building- Billy Frank Jr. Conference Center, 721 NW Ninth Avenue, Portland, Oregon

(See attached file: Outreach Call Minutes from 3-13-12.docx)

U.S. EPA Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Wednesday, April 11, 2012; 5:30 pm to 8 pm
St John's Community Center, 8427 N Central St, Portland, OR 97203

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned from the risk assessment and remedial investigation?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

DRAFT

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review — EPA

7:55 Wrap-up — EPA

8pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

U.S. EPA Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ);
Lower Willamette Group (LWG)

Thursday, April, 12, 2012; 12:30 pm to 3:00 pm
Portland Building Auditorium, 1120 SW 5th Avenue, 2nd Floor, Portland, Oregon 97204

12:30 pm Open house*

1:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:
- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

1:10 Burning Questions from the Audience

1:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ
- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned from the risk assessment and remedial investigation?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

DRAFT

1:45 Draft Feasibility Study (FS) — LWG
- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

2:20 Future steps in cleanup process after Draft Feasibility Study — EPA
- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

2:25 Question review

2:55 Wrap-up — EPA

3pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

U.S. EPA Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ);

Wednesday, April 18, 2012; 5:30 pm – 8 pm
June Key Delta Community Center, 5940 N. Albina Street, Portland, OR 97217

5:30 pm Open house*

6:00 Welcome, Meeting Purpose & Agenda review — EPA

Purpose:

- Explain the cleanup options presented in the Draft Feasibility Study
- Provide time for clarification and questions
- Clarify EPAs role in determining the final cleanup plan
- Discuss opportunities for Public Involvement

6:10 Burning Questions from the Audience

6:20 Background & Discussion of Portland Harbor Project — EPA and ODEQ

- Background of Portland Harbor Superfund Site
- Where are we in the process? What have we learned from the risk assessment and remedial investigation?
- Discussion of source control
- Why should I be concerned about Portland Harbor site?

DRAFT

6:45 Draft Feasibility Study (FS) — LWG

- Overview: What will FS tell me? How will it be used?
- Examples and description of clean-up options for Portland Harbor

7:20 Future steps in cleanup process after Draft Feasibility Study — EPA

- Develop Proposed Plan & Record of Decision
- Opportunities for public involvement, information and comments

7:25 Question review

7:55 Wrap-up — EPA

8pm Adjourn

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

U.S. EPA Public Informational Session on the Portland Harbor Draft Feasibility Study

United States Environmental Protection Agency (EPA); Oregon Department of Environmental Quality (ODEQ); Lower Willamette Group (LWG)

Thursday, May, 10, 2012; 5:30 pm – 8 pm
Ecotrust Building, 721 Northwest 9th Avenue, Suite 200, Portland, OR 97209

5:30 pm	Open house*	
6:00	Welcome, Meeting Purpose & Agenda review Purpose: ▪ Explain the cleanup options presented in the Draft Feasibility Study ▪ Provide time for clarification and questions ▪ Clarify EPAs role in determining the final cleanup plan ▪ Discuss opportunities for Public Involvement	EPA
6:10	Burning Questions from the Audience	
6:20	Background & Discussion of Portland Harbor Project ▪ Background of Portland Harbor Superfund Site ▪ Where are we in the process? What have we learned from the risk assessment and remedial investigation? ▪ Discussion of source control ▪ Why should I be concerned about Portland Harbor site?	EPA and ODEQ
6:45	Draft Feasibility Study (FS) ▪ Overview: What will FS tell me? How will it be used? ▪ Examples and description of clean-up options for Portland Harbor	LWG
7:20	Future steps in cleanup process after Draft Feasibility Study ▪ Develop Proposed Plan & Record of Decision ▪ Opportunities for public involvement, information and comments	EPA
7:25	Question review	
7:55	Wrap-up	EPA
8pm	Adjourn	

Light refreshments provided during Open House. Representatives United States Environmental Protection Agency, Oregon Department of Environmental Quality, Lower Willamette Group, Natural Resource Trustees, Tribal Government and the Portland Harbor Community Advisory Group (CAG) will be available during open house and after meeting to speak with public.

To: []
Cc: CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Macintyre/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Macintyre/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Macintyre/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Macintyre/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Mark Macintyre/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Sat 3/31/2012 1:27:20 AM
Subject: Partnership offer to advertise FS meetings. (Question for Deb/Chip)

Hi Deb, Chip and Kristine,
During the March 13 planning meeting Krista, on behalf of the Partnership, offered to advertise the upcoming FS public meetings on their site. General consensus was that it was not a good idea, but we did not confirm who should contact her. Currently the meetings do not appear on the Partnership site. Please advise if I should send the message below to Krista.

"Hello Krista,
During the March 13 call, an offer was made on behalf of the Partnership to advertise the upcoming FS public sessions. After considering the offer, we request that the Partnership direct those who may be interested to the EPA website www.epa.gov/region10/portlandharbor for information. Please feel free to call if you have questions. Thank you."

Inactive hide details for Alanna Conley---03/19/2012 01:29:02 PM---All, Attached is the draft announcement and agenda for upcomAlanna Conley---03/19/2012 01:29:02 PM---All, Attached is the draft announcement and agenda for upcoming FS Public Information Sessions. Plea

From: Alanna Conley/R10/USEPA/US
To: Wenona Wilson/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 03/19/2012 01:29 PM
Subject: FS Public Information Sessions & Open House. Please provide feedback on short Public announcement language by tomorrow. (Question for Deb/Chip)

All, Attached is the draft announcement and agenda for upcoming FS Public Information Sessions. Please provide your comments on Public Announcement by tomorrow. EPA, Oregon DEQ and LWG look to begin advertising this week.

During my last FS planning call, Krista Koehl switched hats and offered the Partnership's assistance in advertising/announcing the FS Public Information Sessions. I suggested that we decline her offer and only advertise the Public Sessions via EPA, ODEQ, LWG and CAG websites. Deb/Chip - if you agree, who should send email declining Partnerships offer to advertise? I don't mind doing since she mentioned during the call and coping you both. let me know.

Agenda attached - Draft final agenda that EPA, DWQ and LWG agreed on last week.

PUBLIC ANNOUNCEMENT

Public Information Sessions for Portland Harbor Feasibly Study (Please provide comments on announcement language below by tomorrow)

The Draft Feasibility Study for Portland Harbor is scheduled for release on March 30, 2012. The Feasibility Study (FS) is a comparison of clean-up options to manage contaminated soil and river sediment at Portland Harbor Superfund Site. A group of potential responsible parties known as the Lower Willamette Group (LWG) prepared the Study and will submit to the U.S. Environmental Protection Agency (U.S. EPA) for review. The FS is the second major deliverable in the Superfund process, after the remedial investigation (RI) that was submitted in 2009.

A series of Information Sessions will be offered to introduce the Feasibility Study to the public. The purpose of the Public Information Sessions is to discuss the cleanup alternatives, as described in the Feasibility Study, for Portland Harbor. Information about the site background, how the site may affect the community, and opportunities for public involvement will also be discussed. The U.S. Environmental Protection Agency, Lower Willamette Group and Oregon Department of Environmental Quality (ODEQ) will host the Public Information Sessions.

Open house with light refreshments will be held directly before the Public Information Sessions. Representatives from U.S. EPA, LWG, ODEQ, Tribal Government, Natural Resource Trustees and the Portland Harbor Community Advisory Group will be available to meet you, talk with you and provide outreach materials on Portland Harbor.

1st Meeting, Wednesday, April 11, 2012
CAG Meeting
St John's Community Center
5:30 p.m. to 8:00 p.m.
8427 N. Central St.
The room is reserved and paid for.

2nd Meeting, Thursday, April 12, 2012
Portland Building Auditorium
12:30 p.m. to 3:00 p.m.
1120 SW 5th Avenue, 2nd Floor
This meeting will be taped

3rd Meeting, Wednesday, April 18, 2012
June Key Delta Community Center
5:30 p.m. to 8:00 p.m.
5940 N. Albina Street
The room is reserved and the paperwork has been submitted; waiting for finalization of EPA Insurance letter.

4th Meeting, Thursday, May 10, 2012
Ecotrust - Billy Frank Jr. Conference Center
5:30 p.m. to 8:00 p.m.
721 NW Ninth Avenue
Contract being completed by LWG

(See attached file: FS Agenda 3-19-12.docx)

[attachment "FS Agenda 3-19-12.docx" removed by Alanna Conley/R10/USEPA/US]

To: CN=Burt Shephard/OU=R10/O=USEPA/C=US@EPA;GAINER Tom [GAINER.Tom@deq.state.or.us]; AINER Tom [GAINER.Tom@deq.state.or.us]; ennifer L Peterson [PETERSON.Jenn@deq.state.or.us]; eremy_buck@fws.gov;anderson.jim@deq.state.or.us;CN=Joe Goulet/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;MCCLINCY Matt [MCCLINCY.Matt@deq.state.or.us]; nderson.jim@deq.state.or.us;CN=Joe Goulet/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;MCCLINCY Matt [MCCLINCY.Matt@deq.state.or.us]; N=Joe Goulet/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;MCCLINCY Matt [MCCLINCY.Matt@deq.state.or.us]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;MCCLINCY Matt [MCCLINCY.Matt@deq.state.or.us]; CCLINCY Matt [MCCLINCY.Matt@deq.state.or.us]; OULSEN Mike [POULSEN.Mike@deq.state.or.us]; N=Rene Fuentes/OU=R10/O=USEPA/C=US@EPA;Robert.Neely@noaa.gov;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;tomd@ctsi.nsn.us;erin.madden@gmail.com;jay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; obert.Neely@noaa.gov;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;tomd@ctsi.nsn.us;erin.madden@gmail.com;jay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; N=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;tomd@ctsi.nsn.us;erin.madden@gmail.com;jay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; omd@ctsi.nsn.us;erin.madden@gmail.com;jay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; rin.madden@gmail.com;jay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; ay.field@noaa.gov;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; N=Mark Ader/OU=R10/O=USEPA/C=US@EPA;audiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; udiehuber@ctuir.com;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA;LavelleJM@cdm.com;Michael.Karnosh@grandronde.org;dallen@stratusconsulting.com;jpeers@stratusconsulting.com;Bob Dexter [bob@ridolfi.com]; N=Sheila

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Cc: []

From: CN=Chip Humphrey/OU=R10/O=USEPA/C=US
Sent: Tue 4/3/2012 8:41:31 PM
Subject: TCT meeting 4/4/2012

We will be having a TCT meeting tomorrow, Wednesday April 4th from 9 to 11:30am. The Portland location will be the EPA Oregon Operations Office conference room.

The conference line is Personal Privacy / Ex. 6 passcode Personal Privacy / Ex. 6

Please let us know if you have anything to add to the list below, or feel free to bring up at the meeting
thanks
Chip

1) Early Action updates

2) RI/FS

- Community Outreach/Meetings (April 11, 12, 18 & May 10)
- Update on other outreach & activities (Congressional, PH Partnership, LWG briefings, WRK science pub)
- Recent media coverage
- Planning for LWG FS Roll-out meeting April 24, 25
- Another Brattle Group white paper lands
- Update on risk assessment comments
- FS review plans & schedule

Uplands Site updates

To: Lori Cora/R10/USEPA/US@EPA[]
From: Alanna Conley/R10/USEPA/US@EPA
Sent: Wed 4/4/2012 1:36:00 AM
Subject: [epa-nworegon] US EPA Holds Public Information Sessions for Portland Harbor Draft Feasibility Study - First session will be held on April 11

US EPA Holds Public Information Sessions for Portland Harbor Draft Feasibility Study

The United States Environmental Protection Agency (EPA) is reviewing the draft Feasibility Study for the Portland Harbor Superfund Site. You can review it too at the Multnomah County Central Library, 801 SW 10th Ave., or on the EPA website at www.epa.gov/region10/portlandharbor.

Under the direction of EPA, a group of potentially responsible parties known as the Lower Willamette Group (LWG) prepared the feasibility study. The study compares options to clean up Portland Harbor. These options will help manage contaminated soil and river sediment.

EPA will hold four public information sessions to provide an overview of the draft feasibility study. These sessions will include:

· Information about cleanup alternatives
· Site background information
· Discussion of effect on the community
· Next steps for making clean up decisions
· Opportunities for public involvement

In addition, open houses are scheduled before each session. During these open houses, you can speak with representatives from EPA, Oregon Department of Environmental Quality, LWG, Tribal governments, Natural Resource Trustees and the Portland Harbor Community Advisory Group.

1st Meeting —Wednesday April 11
Open House: 5:30-6 pm
Information Session: 6 -8 pm St John's Community Center
8427 N Central St.
Portland
2nd Meeting—Thursday April 12
Open House: 12:30-1 pm
Information Session: 1 -3 pm Portland Building Auditorium, 2nd Floor
1120 SW 5th Ave.
Portland
3rd Meeting—Wednesday April 18
Open House: 5:30-6 pm
Information Session: 6 -8 pm June Key Delta Community Center
5940 N Albina
Portland
4th Meeting—Thursday May 10
Open House: 5:30-6 pm
Information Session: 6 -8 pm Ecotrust Building—Billy Frank Jr. Conf. Room
721 NW 9th Ave.
Portland

See you there!

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To: Barbara Smith [barbara@harrisandsmith.com]; nn Beier [ann.beier@portlandoregon.gov]; laire Levine [c3l@nwnatural.com]; harlie Burr [Charlie.Burr@edelman.com]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;David Harvey [david.harvey@gbrx.com]; avid Harvey [david.harvey@gbrx.com]; iane Mayse [diane@harrisandsmith.com]; Jim McKenna " [jim.mckenna@verdantllc.com]; ennifer Woronets [jworonets@anchorqea.com]; im Heiting [kah@nwnatural.com]; elly Madalinski [Kelly.Madalinski@portofportland.com]; im.Cox@portlandoregon.gov;Krista.Koehl@portofportland.com;MCatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;tina@larjcreative.com;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov;CN=Judy Smith/OU=R10/O=USEPA/C=US@EPA;CN=Richard Muza/OU=R10/O=USEPA/C=US@EPA;MCCLINCY.Matt@deq.state.or.us;POULSEN.Mike@deq.state.or.usElizabeth Allen/R10/USEPA/US;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA[]; rista.Koehl@portofportland.com;MCatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;tina@larjcreative.com;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov;CN=Judy Smith/OU=R10/O=USEPA/C=US@EPA;CN=Richard Muza/OU=R10/O=USEPA/C=US@EPA;MCCLINCY.Matt@deq.state.or.us;POULSEN.Mike@deq.state.or.usElizabeth Allen/R10/USEPA/US;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA[]; CatedralKing@chevron.com;Susan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;tina@larjcreative.com;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov;CN=Judy Smith/OU=R10/O=USEPA/C=US@EPA;CN=Richard Muza/OU=R10/O=USEPA/C=US@EPA;MCCLINCY.Matt@deq.state.or.us;POULSEN.Mike@deq.state.or.usElizabeth Allen/R10/USEPA/US;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA[]; usan.Wilson@gbrx.com;anderson.jim@deq.state.or.us;DANAB.Marcia@deq.state.or.us;phalen.dan@epa.gov;tina@larjcreative.com;AEbbets@stratusconsulting.com;JPeers@stratusconsulting.com;robert.neely@noaa.gov;rose@yakamafish-nsn.gov;erin.madden@gmail.com;Lauren.Senkyr@noaa.gov;CN=Judy Smith/OU=R10/O=USEPA/C=US@EPA;CN=Richard Muza/OU=R10/O=USEPA/C=US@EPA;MCCLINCY.Matt@deq.state.or.us;POULSEN.Mike@deq.state.or.usElizabeth Allen/R10/USEPA/US;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Mark Ader/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA;CN=Wenona Wilson/OU=R10/O=USEPA/C=US@EPA[];

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Cc: []
From: CN=Alanna Conley/OU=R10/O=USEPA/C=US
Sent: Tue 4/17/2012 10:48:18 PM
Subject: Portland Harbor Information Sessions
QUESTIONS POSED AT April 11 & 12 PUBLIC INFORMATION SESSION.docx
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(embedded image)

Hello everyone,
In preparation for the Information Session tomorrow, please see the three bullets below:
Questions captured from the April 11 & 12 meetings (thanks Rich),

Two evaluation forms,
A good number attendees verbally expressed wanting more time for the FS discussion. Attendees generally appreciated presenters staying after to speak with them.

Finally, a concerned resident of St. Johns asked that I forward her message. She may attend tomorrow, or the May 10 session. If she responds to my email, I will forward her specific questions or concerns that may not have been adequately answered on April 11. You may be familiar with the article, if not the link below has the referenced article (36 pages). The article discusses dredging, disposal of dredge materials, environmental/economic impacts, innovative technologies and the NY Harbor inter-agency working group on the dredging process.

Thanks and feel free to call me at 503.326.6831 if you should have questions.

----- Forwarded by Alanna Conley/R10/USEPA/US on 04/17/2012 01:37 PM -----

From: Personal Privacy / Ex. 6
To: Alanna Conley/R10/USEPA/US@EPA
Date: 04/17/2012 01:11 PM
Subject: Portland Harbor Clean-up

Alanna
Please share the following with the EPA participating in the Portland, Oregon Harbor Project. Thank you.

Have you reviewed the 2011 Fordham Environmental Law Review, Vol. 8, Issue 2, Article? The title of the article is "The Dredging Crisis in New York Harbor: Present and Future Problems, Present and Future Solutions." The author is Gerard C. Keegan Jr.
I am sending information regarding this article to the CAG, LWG, and the Yakama Nation Tribal Council. I hope the next meeting will allow sufficient time for discussing this additional information.
The meeting on 4/11/12 felt poorly organized in terms of adequate questions and answers. In addition, the power point presentation, information from the EPA experts, and LWG's representatives were boring, canned, and slick.
I hope the next presentation will not be a a dog and pony show but an example of more current methods to presenting power point presentations and ample time for meaningful participation by the audience.

Personal Privacy / Ex. 6
Resident of St. Johns, PDX

http://ir.lawnet.fordham.edu/cgi/viewcontent.cgi?article=1444&context=elr&sei-redir=1&referer=http%3A%2F%2Fwww.google.com%2Fsearch%3Fhl%3Den%26source%3Dhp%26q%3D2011%2BFordham%2BEnvironmental%2BLaw%2BReview%252CThe%2BDredging%2BCrisis%2Bin%2BNew%2BYork%26gbv%3D2%26oq%3D2011%2BFordham%2BEnvironmental%2BLaw%2BReview%252CThe%2BDredging%2BCrisis%2Bin%2BNew%2BYork%26aq%3Df%26aqi%3D%26aql%3D%26gs_l%3Dhp.12...2781l25122l0l26482l16l8l0l1l0l1l297l921l0j2j2l4l0.#search=%222011%20Fordham%20Environmental%20Law%20Review%2CThe%20Dredging%20Crisis%20New%20York%22

To: Lori Cora/R10/USEPA/US@EPA[]
From: Alanna Conley/R10/USEPA/US@EPA
Sent: Thur 5/3/2012 1:18:55 AM
Subject: [epa-nworegon] Invitation: Portland Harbor Community Advisory Group May Presentation, Wednesday, May 9, 6pm

You are invited to attend the Portland Harbor Community Advisory Group meeting on Wednesday, May 9, 2012.

Meetings of the Portland Harbor Community Advisory Group (PH CAG) are intended to keep the community abreast of developments on the Portland Harbor Superfund Site and to provide a forum for discussion. PH CAG meetings are open to everyone. We encourage you to step forward to share your concerns and advice.

Date: Wednesday, May 9, 2012
Time: 6:00 - 8:00 p.m.
Location: 6543 N Burlington Avenue (Portland BES Water Pollution Control Lab)

Agenda:
1. Welcome and CAG announcements- Jim Robison, President, Portland Harbor CAG

2. Portland "Big Pipe" project video presentation

3. Portland Harbor draft feasibility study overview from the community's perspective- Dr. Peter deFur, CAG Technical Advisory Consultant

4. Closing remarks - Jim Robison

See you soon!

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To: Lori Cora/R10/USEPA/US@EPA[]
From: Alanna Conley/R10/USEPA/US@EPA
Sent: Thur 5/3/2012 1:30:58 AM
Subject: [epa-nworegon] Invitation: EPA Public Information Session for the Portland Harbor Draft Feasibility Study, May 10, 6pm, Ecotrust Building

You are invited to attend the Public Information Session for Portland Harbor Draft Feasibility Study

Date: Thursday, May 10
Time: 6 -8 pm, Open House, 5:30-6 pm
Location: Ecotrust Building—Billy Frank Jr. Conf. Room, 721 NW 9th Ave., Portland, Oregon

The United States Environmental Protection Agency (EPA) is now reviewing the draft Feasibility Study for the Portland Harbor Superfund Site. The Feasibility Study is the mechanism for the development, screening, and detailed evaluation of different cleanup plans and methods. It is also now available for review by the public at the Multnomah County Central Library, 801 SW 10th Ave., or from the EPA website at www.epa.gov/region10/portlandharbor.

EPA is holding a public information session to provide an overview of the draft feasibility study on May 10. This session will include:

- Information about cleanup alternatives
- Site background information
- Discussion of effect on the community
- Next steps for making clean up decisions
- Opportunities for public involvement

In addition, an open house is scheduled before the session. During the open house, you can speak with representatives from EPA, Oregon Department of Environmental Quality, LWG, Tribal governments, Natural Resource Trustees and the Portland Harbor Community Advisory Group.

See you there!

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To: Lori Cora/R10/USEPA/US@EPA[]
From: "Christine L. Hein"
Sent: Wed 5/30/2012 8:13:10 PM
Subject: Portland Harbor White Paper Signatories Group Follow Up
chein@batemanseidel.com
www.batemanseidel.com
mailto:Cora.Lori@epamail.epa.gov
brave.jennifer@epa.gov
cora.lori@epa.gov
image001.gif

Dear Lori:

Thank you for your April 4, 2012 note responding to Greg Christianson's March 9 email regarding the continuing concerns of the 45 signatories to the October 2011 white paper with respect to the risk assessment and RAL-setting process for Portland Harbor. After ably coordinating this group for some time, Greg has stepped aside from that role, although he and his clients will remain active members. I have undertaken the role of group coordinator in his place and look forward to working with you and others at EPA on the important technical issues this group has identified that are critical to reasonable risk management decisions and the overall remedy selection process.

Your April 4 note correctly summarized the three principal requests this group has made for ensuring that the materials and analyses the group has prepared are fully evaluated by the appropriate EPA technical staff and management. The following addresses these three requests.

1. A Meeting with EPA Region 10 Management

As you know, our October 18, 2011 technical white paper was addressed to Regional Administrator Dennis McLerran and included a request for a meeting with Region 10 senior management. EPA's response was that these technical issues should be addressed in the first instance by technical staff rather than management. We agreed to that request, and subsequently met with you, remedial project managers Chip Humphrey and Kristine Koch, and others in Seattle on February 23, 2012. As discussed in Greg's March 9 follow-up note to you, we found that meeting constructive and informative. We understand from that meeting that PRGs are not yet final, that the RALs currently being used in the FS to evaluate remedial alternatives are subject to change, and that risk management decisions are still in the formative stage. The evaluations we wish to discuss are highly relevant to each of these determinations.

At the end of our February 23 meeting and in Greg's March 9 note, we requested a follow-up meeting with Region 10 senior management. In view of the magnitude of these issues we believe that this meeting should include both Dan Opalski and Dennis McLerran. We were disappointed that your April 4 note proposed that the management meeting would not include Mr. McLerran. The Regional Administrator's direct involvement is warranted given that the key issues our white paper identified are currently and directly under consideration in EPA's review of the Draft FS Report. EPA's review must be an informed one that fully takes into account the evaluations we have presented. The Regional Administrator can facilitate a process to help ensure that this meaningful consideration takes place. We again request that Mr. McLerran participate when we meet with Region 10 senior management.

Regarding the timing for the meeting, we suggest scheduling it approximately two weeks after EPA issues its comments on the BHHRA. Our understanding is that EPA will issue those comments soon. This means that the meeting could take place sometime in June. It might be prudent to reserve some specific dates now on our calendars. To that end, we propose holding that meeting on June 19th, 20th, 26th or 27th. Please let us know if these dates might work and so we can get the meeting scheduled.

2. Meaningful Input into the Risk Management Decision-Making Process

We appreciate that EPA (both under the NCP and as a matter of policy) must provide opportunities for public input regarding its Portland Harbor CERCLA process, while keeping those opportunities focused so as not to interfere with timely completion of the RI/FS, Proposed Plan and ROD. I expect that our signatory group, individually and probably also collectively, will provide input when EPA establishes those public comment periods.

However, our white paper signatory group includes a substantial number of GNL recipients and other PRPs who have a significant stake in the process and have raised specific technical concerns. It is appropriate for these parties to provide meaningful and specific input (aside from the public comment period) to the risk management decision-making process so that these issues are adequately evaluated when EPA finalizes PRGs, RALs, and other risk management metrics. Our goal is to provide meaningful input during the process in a way that assists EPA in arriving at remedial action decisions that performing parties, other PRPs and the public can accept.

3. Input to the CSTAG and other EPA Offices outside Region 10

Your April 4 note stated that EPA's practice is not to invite PRPs to take part in review meetings between CSTAG, the NRRB and the Regions. What we've requested, however, is something different. We would like an opportunity to make a direct presentation to the CSTAG regarding the technical issues presented in our white paper that are specific to contaminated sediment sites and within CSTAG's specific area of expertise. EPA's operating procedures for CSTAG expressly permit presentations from key stakeholder groups such as ours and we believe it would be very constructive and significantly strengthen the administrative record.

Thank you again for helping set up the February 23 meeting and for your April 4 note. We will be in contact with you shortly to coordinate the follow-up meeting with EPA Region 10 senior management discussed above.

Best Regards,

Christine

Christine L. Hein

Bateman|Seidel

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From: Lori Cora [mailto:Cora.Lori@epamail.epa.gov]
Sent: Wednesday, April 04, 2012 9:37 AM
To: Christianson, Greg
Cc: Chip Humphrey; Kristine Koch
Subject:

Hello, Greg. I am responding to your email from March 9, 2012. From your email, we understand that the 45 signatories to the October White Paper are requesting the following things:

1. a meeting with EPA management to discuss policy issues regarding the Portland Harbor remedy;
2. would like an appropriate means for ensuring the Signatories are provided a meaningful opportunity to input in risk management decision-making; and
3. want to share your thoughts with CSTAG and EPA managers who will be reviewing the Portland Harbor remedy and its consistency with work at other sites.

I will provide the agency's general response to each item below. Please don't hesitate to call me to discuss these issues further.

1. Dan Opalski, Director of the Environmental Cleanup Office, will meet with representatives of the signatories regarding your risk assessment issues and other issues raised in the white paper. However, we believe such a meeting would be more productive after the group has seen EPA's comments on both the human health risk assessment and ecological risk assessments which we believe may address your issues on transparency. EPA expects to have our human health risk assessment comments to the LWG in the next few weeks. EPA's comments on the ecological risk assessment are anticipated to be issued by June.

EPA is not planning regular meetings with the signatories. When you choose to schedule the meeting with Mr. Opalski, your group should consider when you may have all the relevant information or at least the agency's thoughts on the baseline risk assessments.

2. EPA intends for the signatories and all PRPs along with entire Portland community to have meaningful opportunities to provide input into the draft Feasibility Study, and the Proposed Plan for Portland Harbor. As you are aware, the draft FS was received last week. A complete copy is in EPA's Information Repository at the St. John's Library and on EPA's Portland Harbor website. EPA is seeking input from the community, including PRPs, on the draft FS concurrent with our review of it. Although this is not a formal comment period and EPA will not be responding to comments received, we encourage the signatories to review the document and provide your input in writing to EPA staff. EPA expects our review will take 4-6 months and we would appreciate receiving your input within that time frame.

EPA has scheduled four overview sessions on the draft FS. We encourage all signatories to attend one of the sessions:Wednesday,
Wednesday, April 11, 2012, 6 p.m. to 8:00 p.m.
(Open House 5:30 to 6 p.m.)
St. John's Community Center
8427 N. Central Street, Portland, Oregon

Thursday, April 12, 2012, 1 p.m. to 3:00 p.m.
(Open House 12:30 to1 p.m.)
Portland Building Auditorium
1120 SW 5th Avenue, 2nd Floor, Portland, Oregon

Wednesday, April 18, 2012, 6 p.m. to 8:00 p.m.
(Open House 5:30 to 6 p.m.)
June Key Delta Community Center
5940 N. Albina Street, Portland, Oregon

Thursday, May 10, 2012, 6 p.m. to 8:00 p.m.
(Open House 5:30 to 6 p.m.)
Ecotrust Building- Billy Frank Jr. Conference Center
721 NW Ninth Avenue, Portland, Oregon

If EPA schedules any other public meetings, workshops, etc., all PRPs will be invited. Additionally, EPA anticipates we will schedule a status update meeting for PRPs after our review of the draft FS is complete, probably sometime this Fall.

3. With regard to sharing your thoughts on Portland Harbor risk management decisions with CSTAG and other EPA managers, it is EPA's practice to provide commentson the RI/FS received from PRPs to the National Remedy Review Board and we would provide them to CSTAG as well. The public nor PRPs are invited to attend NRRB or CSTAG review sessions with the Regions. When preparation for NRRB and CSTAG reviews are scheduled, EPA will notify the PRPs of the opportunity to provide comments and the specific page limits and other relevant protocols

that apply.

To schedule the meeting with Mr. Opalski, please contact Jennifer Brave at (206) 553-6241, or brave.jennifer@epa.gov.

I would be happy to discuss our responses or any other questions you may have about the decision-making process moving forward.

Lori Houck Cora | Assistant Regional Counsel
U.S. Environmental Protection Agency | Region 10
P: (206) 553.1115 | F: (206) 553.1762 | cora.lori@epa.gov

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To: CN=James Woolford/OU=DC/O=USEPA/C=US@EPA;CN=Dan Opalski/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cohen/OU=R10/O=USEPA/C=US@EPA;CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Dan Opalski/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cohen/OU=R10/O=USEPA/C=US@EPA;CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cohen/OU=R10/O=USEPA/C=US@EPA;CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Shawna Bergman/OU=DC/O=USEPA/C=US@EPA;CN=Mathy Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Mathy

Stanislaus/OU=DC/O=USEPA/C=US@EPA;CN=Larry
Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb
Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna
Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Larry
Zaragoza/OU=DC/O=USEPA/C=US@EPA;CN=Deb
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Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Alanna
Conley/OU=R10/O=USEPA/C=US@EPA[]; N=Alanna Conley/OU=R10/O=USEPA/C=US@EPA[]
Cc: CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Chip Humphrey/OU=R10/O=USEPA/C=US
Sent: Tue 7/24/2012 12:21:42 AM
Subject: Portland Harbor Partnership Pre-Brief
Mathy PreBrief PH Partnership 7-23-2012.docx

All - Attached is a background/issue summary for the Mathy pre-brief in preparation for the Portland Harbor Partnership meeting.

Chip Humphrey
EPA Region 10
Oregon Operations Office
(503) 326-2678

To: CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA[]
Cc: CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Chip Humphrey/OU=R10/O=USEPA/C=US
Sent: Wed 7/25/2012 3:30:33 PM
Subject: Re: draft email to Bob Wyatt re: proposed first meeting and requested ground rules

Looks good - suggest sending this morning before their Exec session is finished

From: Lori Cora/R10/USEPA/US
To: Kristine Koch/R10/USEPA/US@EPA
Cc: Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA
Date: 07/25/2012 08:25 AM
Subject: Re: draft email to Bob Wyatt re: proposed first meeting and requested ground rules

My draft message includes that point.

Lori Houck Cora | Assistant Regional Counsel
U.S. Environmental Protection Agency | Region 10
P: (206) 553.1115 | F: (206) 553.1762 | cora.lori@epa.gov

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To: Lori Cora/R10/USEPA/US@EPA
Cc: Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA
Date: 07/25/2012 07:56 AM
Subject: Re: draft email to Bob Wyatt re: proposed first meeting and requested ground rules

Lori - I think we should make the point that they need to have representatives that are able to make decisions at these meetings. We have had problems with trying to resolve issues in the past because the representatives we were meeting with had to take it back to the group for agreement. This would not be a good use of our time.

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

(206)553-6705
(206)553-0124 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

From: Lori Cora/R10/USEPA/US
To: Deb Yamamoto/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA
Date: 07/24/2012 05:14 PM
Subject: draft email to Bob Wyatt re: proposed first meeting and requested ground rules

Deb, Kristine and I discussed sending an email to Bob W. from Deb (given we have no higher level manager designated as a contact point for the LWG). Here is a draft of what I understood we discussed.

Bob: EPA is in receipt of the LWG's Notice of Objection to EPA Notice of Non-Compliance and Directed Revisions to the Portland Harbor Draft Final Baseline Human Health Risk Assessment and Request for Dispute Resolution dated July 23, 2012. EPA is reviewing the documents that you provided in support of your Notice of Objection.

I am writing this email because now that a dispute has been raised, typically EPA's first line management participates in trying to resolve disputed issues. The AOC provides that there is a 14-day period for seeking to reach resolution prior to the LWG deciding whether to seek the Office Director's decision. We would like to schedule a meeting on Tuesday, July 31, 2012 , 9 a.m. to Noon, in Seattle as our first session to try to work through the issues. We hope the LWG can accommodate this day and time because EPA's toxicologist will be having minor surgery and out of the office for the next couple days after the 31st.

Another protocol issue I would like to get established are the LWG's points of contact for project level, legal, and management communications as we go through this dispute process. It will be more efficient if EPA has specific people to call to arrange meetings, discuss issues, make proposals, etc. Please supply us with the names and contact information for each of those three levels.

We believe it very important that when EPA and the LWG meet during the next 14 days that all parties come in good faith to seek resolution of the issues and that all parties come with the authority to agree to resolutions. If managers need to be involved but cannot make the meeting, I trust they will be available for caucuses or other real time consultation. Please provide your confirmation that LWG will staff meetings in such a way to have authority to make agreements on dispute issues.

We look forward to hearing back from you on our proposed meeting day and time and other protocol matters.

Lori Houck Cora | Assistant Regional Counsel
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Cc: CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Elizabeth Allen/OU=R10/O=USEPA/C=US
Sent: Wed 8/29/2012 5:35:07 PM
Subject: Revised BHHRA
2012_8-27_BHHRA_Main_Text_clean.doc

OK, I've gone through the tasks assigned to me at our August 27 meeting. Resolutions to specific numbered comments from the LWG's Table 2 are:

5 - I added some text to Section 3.2.1.8 noting that there are no known current uses of the LWR as a drinking water source. However, it turns out that for some reason household water use was never mentioned in the subsequent discussion of exposure pathways associated with surface water in Section 3.3.3, and I added domestic water use to that discussion.

13 - I deleted the existing sentence fragment that was at the beginning of the paragraph in Section 2.3.2, and deleted "generally" from the phrase that RSLs and MCLs were generally used as screening values. Otherwise, the language is correct and needs no further modification.

22 - Text regarding the purpose of the CT evaluations was added to the Section 3.4 discussion of exposure concentrations.

29 - An unneeded reference to Section 5.1.3 was added to Section 3.5.5

34 - Specific tribal consumption rates for salmon, lamprey (ick!), and sturgeon were added to Section 3.5.10.7.

42 - I cleaned up the discussion in Section 5.2.6.3 a bit, and clarified that dioxins and furans were not analyzed for in fillet samples collected in Round 1.

44 - We agree that cPAHs aren't the primary contributors to the HI at RMs 5W and 6W, and revised Section 5.2.6.7 accordingly.

48 - I added text to Section 6.0 that states that EPA considers RME to represent the high end of the possible risk distribution, and that it is considered to be greater than the 90th percentile. The reference comes from the 1992 Habicht memo on Guidance for Risk Characterization for Risk Managers and Risk Assessors.

49 - LWG is to propose language, but my recommendation is to delete the section. The above-cited 1992 memo notes that "noteworthy" uncertainties are to be presented, defined as information that significantly influences the analysis. The conclusion at the end of Section 6.1.2 (and several others) that the specific uncertainties discussed don't really affect the conclusions seems to be at odds with the true intent of a presentation of uncertainties.

52 - We previously added the requested reference to fillet samples in Section Section 6.1.10. I don't agree

that deleting the reference to PCBs is appropriate. The discussion here is noting that both dioxins and dioxin-like PCB congeners typically contribute significantly to risk estimates in instances where the specific analyses were available. Hence, the reference to PCBs as well as dioxins here is appropriate.

57 - I revised the text in Section 6.2.5.5 to note that arsenic data from fish samples are reported as total arsenic, while EPA toxicity criteria are based on inorganic arsenic. The discussion is about the fudge-factor applied to convert total arsenic concentrations to inorganic concentrations. Given that the conclusions of this section are that none of it is a big deal, I think the revised text is fine and am not interested in further discussions regarding the number of angels that can dance on the head of a pin.

I made some revisions to Section 7, which was a mishmash from Day 1. The LWG was already using the term COC there, when they claimed to have decided not to do so. I think it was simply so confusing even they couldn't keep track. The whole point of the discussion is to define chemicals that potentially pose unacceptable risk, and the pathways associated with risks >10-6 and HI > 1. In essence, the LWG's revered "conclusions." I changed references to "primary contributors to risk," which was only a subjective term even in their use. They are now are termed as contributing significantly to the risk estimates, to which I attach no specific legal meaning. Same for primary contributors to risk, which now reside solely in Section 5. I don't think we need to argue further about the terms.

Elizabeth Allen
Office of Environmental Assessment
Risk Evaluation Unit
US Environmental Protection Agency, Region 10
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PORTLAND HARBOR RI/FS

FINAL REMEDIAL INVESTIGATION REPORT

APPENDIX F

BASELINE HUMAN HEALTH RISK ASSESSMENT

FINAL

, 2012

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LIST OF ACRONYMS

ACG	analytical concentration goal
ADAF	age-dependent adjustment factor
ALM	Adult Lead Methodology
AOPC	Area of Potential Concern
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BEHP	Bis 2-ethylhexyl phthalate
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
Cal EPA	California Environmental Protection Agency
CDC	Centers for Disease Control
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
cm/hr	centimeters per hour
CNS	central nervous system
COI	contaminant[1] of interest
COPC	contaminant1 of potential concern
CRITFC	Columbia River Inter-tribal Fish Commission
CSM	conceptual site model
CT	central tendency
DA_{event}	absorbed dose per event
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
delta-HCH	delta-hexachlorocyclohexane
DEQ	Oregon Department of Environmental Quality
DL	detection limit
DQO	data quality objective
E	east
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
EPD	effective predictive domain
FS	feasibility study
g/day	grams per day
GI	gastrointestinal
GSI	Groundwater Solutions, Inc.
HEAST	Health Effects Assessment Summary Table
HHRA	human health risk assessment

[1] Prior deliverables and some of the tables and figures attached to this document may use the teRM "Chemical of Interest" or "Chemical of Potential Concern", which as the same meaning as "Contaminant of Interest" or "Contaminant of Potential Concern", respectively, and refers to "contaminants" as defined in 42 USC 9601(33).

HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic model3
IRAF	Infant Risk Adjustment Factor
IRIS	Integrated Risk Information System
ISA	initial study area
K_p	dermal permeability coefficient
L/day	liters per day
LADI	lifetime average daily intake
LOAEL	lowest observed adverse effects level
LWG	Lower Willamette Group
LWR	Lower Willamette River
µg/dL	microgram per deciliter
µg/kg	microgram per kilogram
µg/L	microgram per liter
MCL	Maximum Contaminant Level
MCPP	2-(4-Chloro-2-methylphenoxy)propanoic acid
mg/kg	milligram per kilogram
ml/day	milliliters per day
ml/hr	milliliters per hour
MRL	method reporting limit
NHANES	National Health and Nutrition Evaluation Survey
NLM	National Library of Medicine
OAR	Oregon Administrative Rules
ODFW	Oregon Department of Fish and Wildlife
ODHS	Oregon Department of Human Services
pg/g	picograms per gram
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PEF	potency equivalency factor
PPRTV	Provisional Peer Reviewed Toxicity Value
PRG	preliminary remediation goal
RBC	risk-based concentration
RfD	reference dose
RG	remediation goal
RI/FS	remedial investigation/feasibility study
RM	river mile
RME	reasonable maximum exposure
RSL	Regional Screening Level
SCRA	site characterization and risk assessment
SF	slope factor
STSC	Superfund Health Risk Technical Support Center
SVOC	semi-volatile organic compound

TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalent
TZW	transition zone water
UCL	upper confidence limit
USDA	United States Department of Agriculture
VOC	volatile organic compound
W	west
WHO	World Health Organization
XAD	XAD-2 Infiltrex™ 300 system

GLOSSARY

Term	Definition
bioaccumulation	the accumulation of a substance in an organism
bioconcentration factor	the concentration of a chemical in the tissues of an organism divided by the concentration in water
central tendency	a measure of the middle or expected value of a dataset
contaminant of concern	the subset of contaminants[2] of potential concern with exposure concentrations that exceed EPA target risk levels
contaminant of interest	contaminant2 detected in the Study Area for all exposure media (i.e., surface water, transition zone water, sediment, and tissue)
contaminant of potential concern	the subset of contaminants2 of interest with maximum detected concentrations that are greater than screening levels
composite sample	an analytical sample created by mixing together two or more individual samples; tissue composite samples are composed of two or more individual organisms, and sediment composite samples are composed of two or more individual sediment grab samples
conceptual site model	a description of the links and relationships between chemical sources, routes of release or transport, exposure pathways, and the human receptors at a site
congener	a specific chemical within a group of structurally related chemicals (e.g., PCB congeners)
human health risk assessment	a process to evaluate the likelihood that adverse effects to human health might occur or are occurring as a result of exposure to one or more contaminants
dose	the quantity of a contaminant taken in or absorbed at any one time, expressed on a body weight-specific basis; units are generally expressed as mg/kg bw/day
empirical data	data quantified in a laboratory
exposure assessment	the part of a risk assessment that characterizes the chemical exposure of a receptor

[2] Prior deliverables and some of the tables and figures attached to this document may use the terms “chemical of concern”, “chemical of interest”, or “chemical of potential concern”, which has the same meaning as “contaminant of concern”, “contaminant of interest”, or “contaminant of potential concern”, respectively, and refers to “contaminants” as defined in 42 USC 9601(33).

exposure pathway	physical route by which a contaminant moves from a source to a human receptor
exposure point	the location or circumstances in which a human receptor is assumed to contact a contaminant
exposure point concentration	the value that represents the estimated concentration of a contaminant at the exposure point
exposure area	size of the area through which a receptor might come in contact with a contaminant as determined by human uses
hazard quotient	the quotient of the exposure level of a chemical divided by the toxicity value based on noncarcinogenic effects (i.e., reference dose)
predicted data	data not quantified in a laboratory but estimated using a model
reasonable maximum exposure	the maximum exposure reasonably expected to occur in a population
receptor	The exposed individual relative to the exposure pathway considered
risk	the likelihood that a specific human receptor experiences a particular adverse effect from exposure to contaminants from a hazardous waste site; the severity of risk increases if the severity of the adverse effect increases or if the chance of the adverse effect occurring increases. Specifically for carcinogenic effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Specifically for noncarcinogenic (systemic) effects, risk is not expressed as a probability but rather is evaluated by comparing an exposure level over a period of time to a reference dose derived for a similar exposure period.
risk characterization	a part of the risk assessment process in which exposure and effects data are integrated in order to evaluate the likelihood of associated adverse effects
slope factor	toxicity value for evaluating the probability of an individual developing cancer from exposure to contaminant levels over a lifetime
Study Area	the portion of the Lower Willamette River that extends from River Mile 1.9 to River Mile 11.8

toxic equivalency factor	numerical values developed by the World Health Organization that quantify the toxicity of dioxin, furan, and dioxin-like PCB congeners relative to 2,3,7,8-tetrachlorodibenzodioxin
transition zone water	Pore water associated with the upper layer of the sediment column; may contain both groundwater and surface water
uncertainty	a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution
upper confidence limit on the mean	a high-end statistical measure of central tendency
variability	a component of risk resulting from true heterogeneity in exposure variables or responses, such as dose-response differences within a population or differences in contaminant levels in the environment

1.0 INTRODUCTION

This Baseline Human Health Risk Assessment (BHHRA) presents an evaluation of risks to human health at the Portland Harbor Superfund Site (Site) in Portland, Oregon. This BHHRA is intended to provide an assessment of potential exposures baseline human health risks due to contaminants at the Site and to support risk management decisions.

Portland Harbor encompasses the Lower Willamette River (LWR) in Portland, Oregon, from the confluence with the Columbia to about River Mile (RM) 12. It has been the focus of numerous environmental investigations completed by the LWG and various other governmental and private entities. Major LWG data collection efforts occurred during four sampling rounds in the LWR from RM 0.8 to 12.2 to characterize the physical system of the river and to assess the nature and extent of contamination in sediment, surface water, transition zone water, storm water, and biota.

The LWG has worked with the United States Environmental Protection Agency (EPA) to develop the methods and assumptions used in this BHHRA. Consistent with EPA guidance (1989), this BHHRA incorporates assumptions to provide a health protective assessment of risks associated with contaminants present at the Site. The risk assessment for Portland Harbor is a baseline risk assessment in that it evaluates human health risks and hazards associated with contamination in the absence of remedial actions or institutional controls.

This BHHRA is being conducted as part of the Remedial Investigation Report (RI Report) to evaluate potential adverse health effects caused by hazardous substance releases at the Site, consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The BHHRA will be used to support the development of contaminant thresholds to be used as preliminary remediation goals (PRGs) for sediment. The PRGs will provide preliminary estimates of the long-terms goals to be achieved by any cleanup actions in Portland Harbor. During the feasibility study (FS) process, the PRGs will be refined based on background sediment quality, technical feasibility, and other risk management considerations. EPA will identify the final remediation goals (RGs) for the site in the Record of Decision, following completion of the FS.

1.1 OBJECTIVES

The general objective of a human health risk assessment in the CERCLA process is to provide an analysis of potential baseline risks to human health from site-related contaminants and help determine the need for remedial actions, provide a basis for determining contaminant concentrations that can remain onsite and still be protective of public health, and provide a basis for comparing the effectiveness of various remedial alternatives. To achieve the overall objectives, the general process of BHHRA is:

- Identify contaminants of potential concern (COPCs)[3]
- Identify potentially exposed populations and pathways of exposure to COPCs
- Characterize potentially exposed populations and estimate the extent of their exposure to COPCs
- Quantitatively characterize the noncarcinogenic and carcinogenic risks to the populations resulting from potential exposure to COPCs and identify contaminants potentially posing unacceptable risks
- Characterize uncertainties associated with this risk assessment
- Identify the contaminants and pathways that contribute the majority of the risk.

1.2 APPROACH

This BHHRA generally follows the approach that was documented in the Programmatic Work Plan (Integral et al. 2004) and subsequent interim deliverables. It also reflects numerous discussions and agreements on appropriate risk assessment techniques for the Site among interested parties, including the EPA, Oregon Department of Environmental Quality (DEQ), Oregon Department of Human Services (ODHS), and Native American Tribes.

Potential exposure pathways, populations, and exposure assumptions were originally identified in the Programmatic Work Plan and in subsequent direction from EPA. Additional assumptions for estimating the extent of exposure were provided in the Exposure Point Concentration Calculation Approach and Summary of Exposure Factors Technical Memorandum (Kennedy/Jenks Consultants 2006) and the Human Health Toxicity Values Interim Deliverable (Kennedy/Jenks Consultants 2004a). Specific documents related to the approach for this BHHRA are presented in Attachment F1. The BHHRA is based on EPA (1989, 1991b, 2001a, 2004, 2005a) and EPA Region 10 (2000a) guidance, and is also consistent with DEQ guidance (DEQ 2000a, 2010).

1.3 SITE BACKGROUND

The LWR extends from the Willamette's convergence with the Columbia River at river mile (RM) 0 upstream to the Willamette Falls at RM 26. Portland Harbor generally refers to a heavily industrialized reach of the LWR between RM 0 and

[3] Prior deliverables and some of the tables and figures attached to this document may use the teRM "Chemicals of potential concern," which has the same meaning as "Contaminants of potential concern" and refers to "contaminants" as defined in 42 USC 9601(33).

RM 12, the extent of the navigation channel. Additional information on the environmental setting of Portland Harbor, including historical and current land use, regional geology and hydrogeology, surface water hydrology, the in-water physical system, habitat, and human access and use is provided in Section 3 of the RI Report. The approximate 10-mile portion of Portland Harbor from RM 1.9 to 11.8 is referred to as the Study Area (Map 1-1). Because the Site boundaries have not yet been defined[4], this BHHRA focused on the Study Area, while also including data collected within the portion of the LWR that encompasses RMs 0.8 to 12.2.

Portland Harbor and the Willamette River have served as a major industrial water corridor for more than a century. Industrial use of the Study Area and adjacent areas has been extensive. The majority of the Study Area is currently zoned for industrial land use and is designated as an "Industrial Sanctuary" (City of Portland 2006a). Much of the shoreline in the Study Area includes steeply sloped banks covered with riprap or constructed bulkheads, with human-made structures such as piers and wharves over the water in various locations. A comprehensive update of Portland's Willamette Greenway Plan and related land use policies and zoning (The River Plan) is underway, addressing all of the Willamette riverfront in Portland (City of Portland 2006b). The Willamette Greenway Plan addresses the quality of the natural and human environment along the Willamette River and generally includes all land adjacent to the river, public lands near the river, and land necessary for conservation of significant riparian habitat. (The Willamette Greenway Plan, adopted by the City Council November 5, 1987, Ordinance 160237). The Greenway Plan is intended to "protect, conserve, enhance, and maintain the natural, scenic, historical, economic, and recreational qualities of lands along Portland's rivers." (Portland City Code Chapter 33.440). The Plan supports industrial uses within Portland Harbor while at the same time looks to increase public access to the river. As a result, recreational use within the Study Area may increase at certain locations in the future.

There are numerous potential human uses of Portland Harbor. Worker activities occur at the industrial and commercial facilities in the Study Area. However, due to the sparse beach areas and high docks associated with most of the facilities, worker exposure to the in-water portion of the Study Area may be limited in shoreline areas. Commercial diving activities also occur in the LWR. In addition, the LWR provides many natural areas and recreational opportunities, both within the river itself and along the riverbanks. Within the Study Area, Cathedral Park, located adjacent to the St. Johns Bridge, includes a sandy beach area and a public boat ramp and is used for water skiing, occasional swimming, and waterfront recreation. Recreational beach use also may occur within Willamette Cove, Swan Island Lagoon, and on the southern end of Sauvie Island. Swan Island Lagoon includes a public boat ramp. Additional LWR recreational beach areas exist on the northern end of Sauvie Island and in Kelley Point Park, both of which are outside of the Study Area.

[4] The Site boundaries will be defined by EPA in the Record of Decision for the Site.

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Fishing is conducted throughout the LWR basin and within the Study Area, both by boaters and from locations along the banks. The LWR also provides a ceremonial and subsistence fishery for Pacific lamprey (particularly at Willamette Falls) and spring Chinook salmon for Native American Tribes. Many areas in the LWR are also important currently for cultural and spiritual uses by local Native Americans.

Transients have been observed along the LWR, including some locations within the Study Area. The observation of tents and makeshift dwellings during RI sampling events confirms that transients were living along some riverbank areas. Transients are expected to continue to utilize this area in the future.

The RI/FS being completed for the Site is designed to be an iterative process that addresses the relationships among the factors that may affect chemical distribution, risk estimates, and remedy selection. Four rounds of field investigations have been completed as part of the RI/FS. A preliminary sampling effort was conducted in 2001 and 2002 prior to the RI/FS work plan. Round 1 was conducted in 2002 and focused primarily on chemical concentrations in fish and shellfish tissue and in beach sediment. Round 2 was conducted in 2004 and 2005 and focused on chemical concentrations in sediment cores, in-water surface sediment, surface water, transition zone water, and additional shellfish tissue and beach sediment. Round 3 was conducted in 2006 and 2007 and focused on chemical concentrations in additional surface water, sediment, and fish and shellfish tissue. These Round 1, Round 2, and Round 3 sampling efforts, while initially focused on RM 3.5 to 9.2, which is the Administrative Order on Consent-defined initial study area (ISA), extended well beyond the ISA to RM 0 downstream and to RM 28.4 upstream.

1.4 ORGANIZATION

In accordance with guidance from EPA (1989), which is consistent with DEQ guidance (2000a, 2010), the BHHRA incorporates the four steps of the baseline risk assessment process: data collection and evaluation, exposure assessment, toxicity assessment, risk characterization, as well as a discussion of overall uncertainties.

This BHHRA is organized as follows:

- Section 2, Data Evaluation – This section evaluates the available data for the Study Area and identifies the COPCs for further evaluation in the BHHRA.
- Section 3, Exposure Assessment – This section presents potentially complete routes of exposure and potentially exposed populations for further evaluation in the BHHRA, which are summarized in the conceptual site model (CSM).
- Section 4, Toxicity Assessment – This section evaluates the potential hazard and toxicity of the COPCs selected for quantitative evaluation in this BHHRA.

- Section 5, Risk Characterization – This section presents the cancer risks and noncancer hazards and identifies the contaminants potentially posing unacceptable risks to human health.
- Section 6, Uncertainty Analysis – This section discusses the uncertainties that are inherent in performing a HHRA, and the uncertainties specific to this BHHRA.
- Section 7, Summary – This section summarizes the findings of this BHHRA and identifies chemicals and pathways that contribute the majority of the risk within the Study Area.
- Section 8, Conclusions – This section provides the conclusions for this BHHRA.
- Section 9, References – This section lists the references used in this BHHRA.

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2.0 DATA EVALUATION

This section presents the data that were used in this BHHRA and the results of the selection of COPCs in sediment, water, and tissue. The LWG and non-LWG sampling events included in the site characterization and risk assessment (SCRA) dataset are described in detail in Appendix A of the RI Report. The dataset used in this BHHRA represents a subset of data from the sampling events that comprised the SCRA dataset as of September 2008. Data needs for the BHHRA were identified through the data quality objective (DQO) process described in Section 7 of the Programmatic Work Plan (Integral et al. 2004). Only data that met Category 1/QA2 data quality objectives was used in the BHHRA. A risk evaluation of exposures to polybrominated diphenyl ethers (PBDEs) detected in in-water sediment, fish and shellfish tissue was conducted using a subset of data from the sampling events that comprised the SCRA dataset as of February 2011. The data for the PBDE analysis are discussed in Attachment F3, and the PBDE risk assessment used the general data evaluation methodology discussed in this section.

2.1 AVAILABLE DATA

The BHHRA dataset includes only those matrices relevant for direct human exposure pathways: surface sediment, clam and crayfish tissue, fish tissue, surface water and groundwater seeps. Other matrices included in the SCRA dataset (such as subsurface sediment) were not evaluated in the BHHRA because human exposure was considered unlikely. Data from RM 1.0, including Multnomah Channel, and upstream to RM 12.2, were included in the risk assessment. The BHHRA dataset is summarized by matrix in Table 2-1. The dataset is described briefly in the following subsections, and described in more detail in Section 2.0 of the RI Report.

2.1.1 Beach Sediment

Areas where potential exposure to beach sediment could occur were based only on current conditions, as identified in the Programmatic Work Plan. Because beaches are relatively dynamic environments, specific beach conditions may change in the future, and the evaluation presented in the BHHRA may no longer be appropriately descriptive of potential risks.

Composite sediment samples were collected during Round 1 from each beach that had been designated as a potential human use area within the Initial Study Area (ISA). Additional human use areas within the Study Area but downstream of the ISA were sampled during Round 2 as part of the sampling of shorebird habitat were also included in the BHHRA dataset. The designated potential human use areas and associated beach sediment samples are shown in Map 2-1, and Table 2-2 presents a summary of the composite sediment samples included in the BHHRA dataset.

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2.1.2 In-Water Sediment

The in-water sediment BHHRA dataset includes samples collected outside of the navigation channel of the river and from less than 30.5 cm in depth. Beach sediment samples are excluded, as well as natural attenuation core samples, radioisotope samples, and samples collected from areas that were subsequently dredged. The in-water sediment dataset is comprised of samples collected within the study area includes samples from river mile (RM) 1 to RM 12.2, including Swan Island Lagoon, as well as samples from the mouth of Multnomah Channel. As described in Appendix A of the RI, samples collected from areas that have subsequently been capped or dredged were not included in the BHHRA dataset. Per an agreement with EPA, the screening of contaminants of potential concern (COPCs) used only the subset of data collected from RM 1.9 to RM 11.8 (and including Swan Island Lagoon and the mouth of Multnomah Channel), whereas the exposure assessment and risk characterization used both subsets of data containing samples from RM 1 to RM 12.2. A summary of in-water sediment samples included in the BHHRA dataset is presented in Table 2-3.

2.1.3 Surface Water

Surface water samples were collected by the LWG in seven separate events during Rounds 2 and 3 between 2004 and 2007, and are representative of various seasonal water flow conditions. Surface water samples were collected between RM 1.9 and RM 11.8 from 32 single point stations and 5 transect locations (at RM 2.0, Multnomah Channel, RM 3.9, RM 6.3, and RM 11). One additional surface water sample was collected from RM 16, outside the boundaries of the Study Area. Surface water samples were collected using either a peristaltic pump or an XAD-2 Infiltrex™ 300 system (XAD). Single point samples included near-bottom and near-surface samples, as well as vertically integrated water column samples. Transect samples included horizontally integrated near-bottom and near-surface samples, cross-sectional equal discharge increment samples horizontally integrated across the entire width of the river , and vertically integrated samples from the east, west, and middle sections of a transect on the river. Additional information on the surface water sampling methods is available in Section 5.3 of the RI Report. Tables 2-5 and 2-6 present a summary of the surface water samples included in the BHHRA dataset from within and outside of the Study Area, respectively.

2.1.4 Groundwater Seeps

A seep reconnaissance survey was conducted during Round 1 to document readily identifiable groundwater seeps along both sides of the river from RM 2 to 10.5 (GSI 2003). Twelve potential groundwater seeps were observed at or near potential human use beach areas. Of these, only three sites were identified in the survey where it was considered likely for upland contaminants of interest (COIs)[5] to reach groundwater seeps or other surface expressions of groundwater discharging to human use beaches: the City of Portland storm sewer Outfall 22B, Willbridge, and McCormick and Baxter at Willamette Cove. Of these locations, only the Outfall 22B discharge was evaluated in the BHHRA. Groundwater infiltrates into the outfall pipe, which subsequently discharges to a beach that has been identified as a potential transient use area. The groundwater seep at Willbridge is at a beach restricted to industrial use, the seep at Willamette Cove, located downgradient of the McCormick and Baxter Superfund Site, was capped during remedial activities in 2004.

The stormwater pipeline that discharges at Outfall 22B provides a conduit for surface discharge of groundwater containing COIs that infiltrates into the pipe upland of the beach. The sampling events at Outfall 22B are described in Appendix A of the RI Report. Although samples have periodically been collected for analysis of the discharge at Outfall 22B both during and outside of stormwater events, samples taken during stormwater events were not included in the BHHRA dataset because they were not considered representative of typical exposures. Samples collected since 2002 were used in the BHHRA, and Table 2-5 presents a summary of the samples that were included in the BHHRA dataset.

2.1.5 Fish Tissue

The target fish species to be evaluated for human consumption were identified in the Programmatic Work Plan (Integral et al. 2004), and consisted of both resident and non-resident species. Samples of resident fish species were collected by the LWG during Rounds 1 and 3. Samples of non-resident fish species were collected in the summer of 2003 through a cooperative effort of the ODHS, Agency for Toxic Substances and Disease Registry (ATSDR), Oregon Department of Fish and Wildlife (ODFW), the City of Portland and EPA Region 10. Table 2-7 presents a summary of the fish tissue samples included in the BHHRA dataset.

2.1.5.1 Resident Fish Tissue

Resident fish species evaluated in the BHHRA are smallmouth bass (*Micropterus dolomieui*), black crappie (*Pomoxis nigromaculatus)*, common carp (*Cyprinus carpio carpio)*, and brown bullhead (*Ameiurus nebulosus*). The sampling protocol for each species differed based on the reported home ranges of species sampled. The tissue compositing scheme for the Round 1 data collection effort was reviewed and approved by EPA in November and December 2002. The Round 3 data collection, the tissue compositing scheme was approved by EPA in October 2007. Smallmouth bass and carp collected during Round 3 were analyzed separately as fillet and the remaining body-without-fillet tissue, and whole body concentrations were calculated using the individual fillet and body-without-fillet results. Thus, for the risk

[5] Prior deliverables and some of the tables and figures attached to this document may use the teRM "Chemicals of interest," which has the same meaning as "Contaminants of interest" and refers to "contaminants" as defined in 42 USC 9601(33).

assessment, the Round 3 smallmouth bass samples were reported both as fillet and whole body results.

Smallmouth bass samples were collected in Round 1 from eight locations between RM 2 and 9, and corresponding to their small home range (ODFW 2005), and composited based on each river mile. Three whole body replicate composite samples were collected at three of the eight locations, one whole body composite sample and one fillet composite sample were collected at the 5 remaining sample locations. Round 3 samples were collected from 18 stations between RM 2 and 12, each corresponding to approximately one river mile, either the west or east side of the river, or both. One composite sample was collected from each station, typically consisting of five individual fish.

Black crappie, common carp, and brown bullhead samples were collected during Round 1 and composited from two three-mile long fishing zones, RM 3-6 and RM 6-9. Three common carp and brown bullhead whole body and fillet replicate composite samples were collected from each zone. Two black crappie whole body and fillet replicate composite samples were collected within each zone. All results from within the Study Area were included in the BHHRA dataset.

During Round 3, common carp samples were collected from three fishing zones, each approximately four river miles in length (RM 0-4, RM 4-8, and RM 8-12). Three common carp composite samples were collected from each fishing zone and analyzed separately as fillet tissue and body-without-fillet tissue. All Round 3 results were included in the BHHRA dataset.

Smallmouth bass, black crappie, and common carp fillet samples were analyzed as fillet with skin, except for the analysis of mercury, which was performed using fillet without skin. Brown bullhead fillet samples were analyzed as fillet without skin.

2.1.5.2 Salmon, Lamprey, and Sturgeon

Adult white sturgeon (*Acipenser transmontanus*), adult spring Chinook salmon (*Oncorhynchus tshawytscha*), and adult Pacific lamprey (*Lampetra tridentate*) were collected during ODHS Study. Although these data were not collected as part of the RI, the data met Category 1/QA2 data quality requirement s and were evaluated by the LWG and used in this BHHRA.

Adult Chinook salmon samples were collected at the Clackamas fish hatchery. Each composite sample consisted of three individual fish. Five whole-body (including one split), three fillet with skin, and three fillet without skin composite samples were analyzed. The fillet without skin composite samples were only analyzed for dioxin, furan, and polychlorinated biphenyl (PCB) congeners and mercury.

Adult Pacific lamprey samples were collected at the Willamette Falls. Four whole body composite samples, each consisting of 30 individual fish, were analyzed.

Adult sturgeon samples were collected between RM 3.5 and 9.2. Six fillet samples were analyzed without skin (including one split), each sample consisting of a single fish.

2.1.6 Shellfish Tissue

Crayfish samples were collected from 24 stations during Round 1 based on habitat areas and from 9 stations during Round 3 based on habitat areas and data needs identified by the EPA. Commensurate with their limited home range, crayfish were collected and analyzed as whole body composite samples from each individual station. During Round 1, two replicate composite samples were collected at three of the 24 stations; a single composite sample was collected at the remaining stations. During Round 3, a single composite sample was collected at each station.

Clams (*Corbicula* sp.) were collected from three stations during Round 1, 33 stations during Round 2, and 10 stations during Round 3, sampling locations were based on habitat areas and biomass availability. A single composite sample was collected at each station in Rounds 1 and 2. In Round 3, two composite samples were collected from each of five stations, and a single composite sample was collected from each of the remaining five stations. Round 1 and Round 2 samples were analyzed undepurated. As previously noted, two samples were collected from five of the sampling station in Round 3, one sample from each station was depurated prior to analysis, the other was analyzed undepurated. At the remaining stations, only undepurated samples were analyzed. Depuration is a common method for cleansing shellfish, that is often done prior to their consumption by humans to eliminate the sediment present in the gastrointestinal tract of the shellfish. Although data from laboratory bioaccumulation samples were also available from Round 2, these data were not used because field-collected tissue samples provide for a more direct evaluation of potential human exposure than laboratory bioaccumulation samples. Tables 2-7 and 2-8 present a summary of the shellfish tissue samples included in the BHHRA dataset, from both inside and outside the Study Area, respectively.

2.2 DATA EVALUATION

Prior to using the data in the BHHRA, the data were evaluated for inclusion in the BHHRA consistent with the Guidelines for Data Reporting, Data Averaging, and Treatment of Non-Detected Values for the Round 1 Database (Kennedy/Jenks Consultants et al. 2004), the Exposure Point Concentration Calculation Approach and Summary of Exposure Factors (Kennedy/Jenks Consultants 2006), and Proposed Data Use Rules and Data Integration for Baseline Human Health Risk Assessment (BHHRA), submitted to EPA in a May 28, 2008 email. Data use rules applied to the combining of surface water data collected by different methods, the handling of non-detects, the summing of chemical groups, and the calculation of exposure point concentrations (EPCs).

2.2.1 Excluded Data

The data used BHHRA meet Category 1/QA2 data quality objectives, as described in Section 2.2 of the RI Report. Data that were not of this quality were removed from the BHHRA dataset. General reductions of the SCRA dataset to create the BHHRA dataset included removal of rejected analytical results ("R" qualified results), and removal of analytical results of samples collected from locations that have been capped, dredged, or remediated. This included all samples flagged as capped, dredged or remediated, including data from task WLCMBI02: the McCormick & Baxter September 2002 Sampling.

2.2.2 Field Replicates

Field replicates within the BHHRA dataset were handled per agreements with EPA. When calculating a mean or an upper confidence limit (UCL), and when reporting data in general, replicates were included in the dataset as discrete samples. Replicates with unique coordinates were included as separate samples when mapping or spatially weighing data. Where replicates have the same coordinates, data associated with the first sample were used and data from the second or third replicates were excluded.

2.2.3 Co-elution of PAHs

Benzo(b+k)fluoranthenes and benzo(k+j)fluoranthenes co-eluted in certain surface water and in-water sediment samples. For the purposes of the BHHRA, benzo(b+k)fluoranthenes results were assumed to be completely benzo(b)fluoranthene, and benzo(k+j)fluoranthenes results were assumed to be completely benzo(k)fluoranthene. Analytical results for these samples were not presented as co-elutions in the BHHRA, but rather, were presented as results for their assumed analyte.

2.2.4 Treatment of PCB Surface Water Data

Polychlorinated biphenyls (PCBs) were analyzed as Aroclors in samples collected using a peristaltic pump, and as congeners in high-volume samples collected using the XAD-2 sampling method. Because detection limits for the peristaltic pump samples were higher than those using high-volume samples, the results for PCBs from the high-volume samples were used. Aroclor concentrations in the high-volume samples were estimated from the PCB congener data by the analytical laboratory. Therefore, Aroclor data were not used, and only PCB congener data were used to assess PCBs in the BHHRA surface water dataset.

2.2.5 Combining XAD Column and Filtered Surface Water Data

The XAD water quality samples consisted of two components: chemicals retained on the column that are representative of the dissolved concentration, and chemicals retained on the filter that are representative of the concentration of the suspended particulate fraction. In order to create a whole water sample from the XAD results, the analytical results for column and filter fractions for a given chemical were combined to give a total concentration. The following rules were used to calculate a whole water concentration for individual samples:

- If an analyte was detected in both the filter and the column, the detected concentrations were summed.
- If an analyte was detected in either the filter or the column but not in both portions of the sample, only the detected concentration was used.
- If an analyte was not detected in both the filter and the column, the highest detection limit reported for either the filter or the column was used.

Surface water samples collected using the high-volume XAD-2 sampling method are identified with the letters "XAD." The results of the combined XAD-2 column and filter data were renamed "WSXAD-Combo," and are presented as such in the BHHRA.

2.2.6 Combining Horizontal and Vertical Surface Water Data

The surface water data described in Section 2.1.3 were vertically integrated prior to use in the BHHRA. Transect samples are presented as a vertically and horizontally integrated transect. Non-integrated samples were collected from both near-bottom and near-surface (NB/NS) depths within the water column at single-point sampling locations. Vertically-integrated transect samples were collected from the east, west, and middle (E/W/M) sections of the river, horizontally integrated samples were collected from NB or NS water depths. NB/NS and/or E/W/M samples from the same location and date were combined to provide an integrated value for the water column or transect. In these cases, single-point data from NB and NS were vertically combined, vertically-integrated data from E/W/M were horizontally combined; and horizontally-integrated data from NB/NS were vertically combined using the following rules:

- If an analyte was detected in each sample, the detected concentrations were averaged.
- If an analyte was detected in at least one sample, the mean concentration was calculated using one-half the detection limit for non-detect results.
- If all results were non-detect, the mean of the detection limits was calculated and used as the non-detected concentration ("U" qualified).

- In some instances, a field replicate sample was collected from the middle of the river without corresponding replicate samples from the east or west side of the river, indicated by "M2" in the Sample ID. The results from these samples were included in the dataset at their reported concentrations, without combining them with other results.

Sample IDs for the results of the horizontally or vertically combined integrated data were renamed to include "-Int" at the end of the ID name, and are presented as such in the BHHRA.

2.2.7 Combining Fillet and Body-Without-Fillet Tissue Data

Smallmouth bass and carp samples collected during the LWG Round 3 sampling event were analyzed separately as fillet and body-without-fillet tissue. The results of these analyses were combined on a weighted-average basis to provide whole body results for use in the BHHRA. The steps used in combining the data were as follows:

- The whole-body tissue mass was calculated for each individual fish within each composite by summing its fillet and body-without-fillet tissue mass.
- The ratio of fillet to whole-body tissue mass was calculated for each individual fish within each composite. Likewise, the ratio of body-without-fillet to whole-body tissue mass was calculated for each individual fish within each composite.
- For each composite, the average of the fillet to whole-body tissue mass ratios was calculated, and the average of body-without-fillet to whole-body tissue mass ratios was calculated to provide an average of the percentage of fillet and body-without-fillet tissue mass for each composite.

The average percentages were then used to calculate a weighted average concentration for each composite sample according to the following rules:

- If the analyte was detected in both the fillet tissue and the body without fillet tissue, a weighted average was calculated using the detected values
- If the analyte was not detected in either of the tissue types, a weighted average was calculated using the full detection limits
- If the analyte was detected either the fillet or body-without-fillet sample, one-half the detection limit for the non-detect result was used to calculate the weighted average.

The combined fillet and body without fillet tissue data were considered whole body tissue results for carp and smallmouth bass and were used in the BHHRA as such.

2.2.8 Summation Rules for Analytes Evaluated as Summed Values

Certain contaminants were evaluated as the sum of similar individual congeners, isomers, and closely related degradation products of the parent compound rather than as individual chemicals. The chemicals evaluated as mixtures and for which analytes evaluated as sums in the BHHRA are as follows:

- Total PCBs were calculated as either the sum of nine Aroclor mixtures (1016, 1221,1232, 1242, 1248, 1254, 1260, 1262, 1268) or the sum of individual PCB congeners.
- Total endosulfan was calculated as the sum of α-endosulfan, β-endosulfan, and endosulfan sulfate.
- Total chlordane was calculated as the sum of *cis*- and *trans*-chlordane, oxychlordane, and *cis*- and *trans*-nonachlor.
- Total DDD was calculated as the sum of 2,4'-DDD and 4,4'-DDD.
- Total DDE was calculated as the sum of 2,4'-DDE and 4,4'-DDE
- Total DDT was calculated as the sum of 2,4'-DDT and 4,4'-DDT
- Total dioxin-like PCB congeners were calculated as the sum of PCBs 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, and 189.
- Total PCBs-adjusted were calculated as the sum of total PCB congeners minus dioxin-like PCB congeners.
- Total xylenes were calculated as the sum of *m*-, *o*-, and *p*-xylene.

The individual components of each chemical mixture used in the BHHRA are presented in Table F2-2.

If an individual analyte of a chemical mixture was detected at least once within the study area in a given medium, it was considered present in that medium. The presence of an analyte in biota samples was assessed separately for each individual species and tissue. The presence of individual analytes in sediment, and surface water were also assessed separately based on the specific exposure scenario. Individual analytes that were a part of a chemical mixture but were determined not to be present are summarized in Table F2-3 by medium and species. Additionally, a minimum number of individual analytical results in the mixture was required for the summed analytical result to be calculated. For example, if a sample was only analyzed for a limited number of individual PCB congeners, or if a large number of individual congener results for a sample were rejected, a total PCB congener sum may not have been calculated. In addition, chemical mixtures for samples meeting the criterion for the minimum number of individual analytical results required to calculate a sum, but with a limited number of individual analytical results, were qualified with an "A." Mixture sums that did not have a limited number of individual analytical results were qualified with a

"T," indicating a calculated total. Table F2-4 shows the minimum number of individual analytical results required to calculate a sum for each mixture, and the maximum number of individual analytical results that would result in an "A" qualifier, indicating a limited number of individual analytical results were available for a sample. Table F2-4 also lists the number of samples for each medium for which a summed total was calculated, and the number of samples for which a summed total was not calculated because of lack of individual analytical results for the mixture. Sample IDs of samples for which a summed analytical result was not calculated are presented in Table F2-5.

Concentrations of the individual analytes that comprise a mixture were summed for each sample according to the following rules:

- If an analyte was detected in the sample, the detected concentration was used to calculate the sum
- If an analyte was not detected in a sample but was assumed to be present in the sample medium, one-half the detection limit was used to calculate the sum
- If all results were non-detect, the highest detection limit of the analytes assumed to be present in the medium was used as the detection limit for the sample, and the sample was flagged as a non-detect.

2.2.9 Total Dioxin/Furan and PCB TEQs

A toxicity equivalence procedure was used to assess the cumulative toxicity of complex mixtures of PCDD, PCDF, and PCB congeners. The procedure involves assigning individual toxicity equivalency factors (TEF's) to the PCDD, PCDF, and PCB congeners in terms of their relative toxicity to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). The reported concentration of each congener in a sample is multiplied by its respective TEF to give the TEF-equivalent concentration. The resulting concentrations are then summed to give a TEQ. The World Health Organization (WHO) TEFs (Van den Berg et al. 2006), shown in Table 4-3, were used to calculate the total dioxin/furan and PCB TEQs. Dioxin/furan and PCB-TEQs were calculated according to the following rules

- Congeners reported as not detected in a given sample but determined to be present in the medium, one-half the detection limit multiplied by the TEF was used in the sum
- If all results in a sample were non-detect, the maximum toxicity-weighted detection limit was used for the TEQ, and the result was flagged as non-detect (U-qualified). The maximum toxicity-weighted detection limit was obtained by multiplying each detection limit by its respective TEF and selecting the maximum value.

- Dioxin/furan TEQs were not calculated for those samples where analytical results for all 12 dioxin/furan congeners were not available.

Values were not presented for total TEQ in the BHHRA. Rather, risks from total TEQ were estimated by summing the risks from the total PCB TEQ and the total dioxin/furan TEQ.

2.3 CHEMICAL SCREENING CRITERIA AND SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

Because of the large number of chemicals detected in environmental media, a risk-based screening approach was used to focus the risk assessment on those contaminants most likely to significantly contribute to the overall risk. COPCs were selected for quantitative evaluation in the BHHRA by comparing the SCRA analytical data to risk-based screening values. The specific risk-based concentrations used to select COPCs are described below for the each media.

2.3.1 Sediment

EPA's Regional Screening Levels (RSLs) for soil (EPA 2010a) were used as the screening values for beach and in-water sediments. RSLs are risk-based concentrations in soil, air and water, and have been developed for both residential and industrial exposure scenarios. Using default exposure assumptions, RSLs represent concentrations that equate to a target cancer risk of 1×10^{-6} or a hazard quotient of 1. As described in Region 10 guidance (2007a), RSLs based on a noncancer endpoint were divided by 10 to give a value equivalent to using a hazard quotient of 0.1. This was done to account for the additive nature of noncancer effects. RSLs based on noncancer endpoints were divided by 10 to account for potential cumulative effects from multiple chemicals, and these modified RSLs were used as the screening values. Consistent with the then current EPA Region 10 recommendations (EPA, 2008), a RSL of 7.7 mg/kg in soil for residential land use was calculated for trichloroethylene (TCE) using a cancer slope factor of 0.089 per mg/kg-day, which represents the geometric mid-point of the slope factor range from EPA 2001. EPA finalized its risk assessment for TCE in 2011 and the revised RSL is 0.9 mg/kg. Because TCE does not contribute substantially to the cumulative risk estimates for the in-water portion of Portland Harbor, the screening process was not re-evaluated. Chemicals for which no RSL was available were screened using RSLs for chemicals with a similar chemical structure.

Because uses of Portland Harbor include both recreational and industrial activities, COPCs were selected using both residential and industrial RSLs, consistent with the EPA comments on the Round 2 Comprehensive Report (EPA 2008b). Residential RSLs were used to select COPCs in beach sediment for those areas where exposures could occur during recreational, transient, or fishing activities in those areas considered reasonably accessible from contiguous upland areas or by boat. In-water sediment data collected within the navigation channel were not used in the COPC screen. In areas where occupational exposures could occur, and for in-water sediment, COPCs were selected using industrial RSLs.

If the maximum detected concentration of a contaminant at a specific use area was greater than its respective screening level, that contaminant was selected as a COPC. The designated potential uses for beaches in the Study Area are presented in Map 2-1. COPCs for beach sediment and the rationale for selection are presented in Tables 2-9 and 2-10. COPCs for in-water sediment are presented in Table 2-11.

2.3.2 Surface Water

EPA residential tapwater RSLs (EPA 2010a) and MCLs (EPA 2003a) were used as screening values for surface water and the groundwater seep to select COPCs for direct exposure scenarios. TCE was evaluated using the EPA Region 6 Human Health Medium-Specific Screening Level (EPA 2008a).

COPCs were selected separately for divers, transient/beach user exposures, and the potential use of surface water as a drinking water source. COPCs for evaluating exposure to divers and for drinking water were selected from the combined surface water data set described in Section 2.2.6. COPCs for transient and beach use scenarios were selected from surface water samples taken from areas where direct contact could occur. A summary of samples used for screening surface water for COPCs is provided in Table 2-12. Sample locations of surface water data evaluated and COPCs for diver exposures are shown on Map 2-3 and in Table 2-13; sample locations and COPCs for transient and recreational beach uses are shown on Map 2-4 and Table 2-14; sample locations and COPCs for the use of surface water as a drinking water source are shown on Map 2-8 and in Table 2-16.

2.3.3 Groundwater Seep

Chemicals concentrations detected in the groundwater seep at Outfall 22B were compared to the residential tapwater RSLs. As with the soil RSLs, the tapwater RSLs based on a noncancer endpoint were divided by 10 to give values equivalent to a HQ of 0.1. The location of Outfall 22B is shown on Map 2-5, and COPCs are presented in Table 2-15.

2.3.4 Fish and Shellfish Tissue

No appropriate risk-based screening values for fish tissue were available. Although EPA Region 3 has published fish tissue screening levels, the consumption rate of 54 g/day used to derive those values is not considered representative of the range of consumption rates relevant to Portland Harbor. Accordingly, all chemicals detected in fish and shellfish tissue in the BHHRA dataset were considered to be COPCs and evaluated further in the BHHRA. The general locations of fish in a particular composite of smallmouth bass and common carp are shown on Map 2-6. Brown bullhead and black crappie were composited over RM 3-6 and RM 6-9. Shellfish were composited over areas representing their assumed home range, and sample locations on Map 2-7 represent the general spatial distribution of composited samples.

3.0 EXPOSURE ASSESSMENT

Exposure assessment is the determination of the magnitude, frequency, duration, and route of exposure (EPA, 1989). Populations that currently, or may in the future, come into contact with site contaminants are identified along with potential routes of exposure that define the mechanism by which the exposure may occur. Magnitude is determined by estimating the amount, or concentration, of the chemical at the point of contact over an exposure duration, as well as the actual intake, or dose, of the chemical.

According to EPA (1989), an exposure assessment includes three primary tasks:

- Characterization of the exposure setting. This step includes identifying the characteristics of populations that can influence their potential for exposure, including their location and activity patterns, current and future land use considerations, and the possible presence of any sensitive subpopulations.
- Identification of exposure pathways. Exposure pathways are identified for each population by which they may be exposed to chemicals originating from the site.
- Quantification of exposure. The magnitude, frequency, and duration of exposure for each pathway is determined. This step consists of the estimating of exposure point concentrations and calculation of chemical intakes.

3.3.1 Conceptual Site Model

The conceptual site model (CSM) describes potential contaminant sources, transport mechanisms, potentially exposed populations, exposures pathways and routes of exposure. As discussed in Sections 4, 5, and 6 of the RI Report, contaminated media within the Study Area are sediment, water, and biota. Current and historical industrial activities and processes within the Study Area have led to chemical releases from either point or nonpoint sources, including discharges to the river from direct releases or via outfalls and groundwater within the Study Area. In addition, releases that occur upstream of the Study Area and atmospheric deposition from global, regional, and local emissions may also represent potential contaminant sources to the Study Area. Chemicals in sediment and water may be accumulated by organisms living in the water column or by benthic organisms in sediments. Fish and shellfish within the Study Area feeding on these organisms can accumulate chemicals in their tissues through dietary and direct exposure to sediment and water. Additional information on potential contaminant sources is provided in Section 4 of the RI Report, and a more detailed CSM is presented in Section 10. A graphical representation of the exposure CSM is presented on Figure 3-1.

3.4 IDENTIFICATION OF POTENTIALLY EXPOSED HUMAN POPULATIONS

Potentially exposed populations were identified based on consideration of current and potential future uses of the Study Area. An analysis of potential exposure pathways for the Study Area is detailed in the Portland Harbor RI/FS Programmatic Work Plan (Integral 2004). The exposure scenarios identified below represent those populations that are anticipated to have the greatest potential for exposure to contaminants within the Study Area for both current and potential future conditions. For this reason, this risk assessment is likely to be protective of other potentially exposed populations that are not evaluated quantitatively in this BHHRA. The receptors evaluated for current and future uses of the Study Area are:

- Dockside workers
- In-water workers
- Transients
- Divers
- Recreational beach users
- Recreational/Subsistence Fishers
- Tribal fishers
- Domestic water users

The above populations were identified based on human activities know to occur within the Study Area, with the exception the use of surface water as a domestic water source. However, public and private use of surface water is a beneficial use of the LWR, and as described in Section 1, this baseline risk assessment evaluates exposures assuming no institutional controls, such as obtaining a permit for use of surface water. Each of these receptors is described in greater detail in the following sections.

3.4.1.1 Dockside Workers

Portland Harbor supports a large number of water-dependent commercial uses, and many of the facilities adjacent to the LWR rely on ship and barge traffic. Dockside workers were evaluated to be representative of industrial and commercial workers at many of the facilities adjacent to the river. Specific activities are assumed to occur only within natural river beach areas, and include unloading ships or barges, or conducting occasional maintenance activities at specific locations near or at the water's edge. Exposures for dockside workers are evaluated as occurring only within defined areas considered to be industrial sites, rather than on a Study Area or harbor-wide basis. The specific areas evaluated are shown on Map 2-1.

3.4.1.2 In-Water Workers

In-water workers were evaluated as representative of individuals who conduct activities that typically occur in or over-water, rather than on shore as assumed for dockside workers. Specific activities may include the repair of in-water structures such as docks or pilings, maintenance dredging of private slips or berths, or maintenance and cleaning of equipment. While such activities would not necessarily be restricted to a given area, exposure would most likely be localized to specific facilities, and between the shore and the navigation channel.

3.4.1.3 Divers

Several different groups of people dive in the Portland Harbor area, including the public for recreation (which may include gathering of biota for consumption), the sheriff's office for investigations and emergency activities, and commercial divers for a variety of purposes including marine construction, underwater inspections, routine operation and maintenance, and activities related to environmental work. The majority of divers are expected to be commercial divers who typically use either wet or dry suits, wet or dry gloves, and a full face mask or a regulator held in the mouth with the diver's teeth. Although dry suits provide greater protection, wetsuits are occasionallyused because of the higher cost of dry suits and higher water temperature (Sheldrake et. al, 2009). The Willamette River is 303d listed as a temperature impacted area, with the Lower Willamette reaching average temperatures of over 70 degrees F in the summer months. Based on communications with commercial diving companies in the Portland area (Hutton 2008, Johns 2008, and Burch 2008), the standard of practice for commercial divers is the use of dry suits and helmets when diving in the LWR. However, the use of wet suits is apparently still common among many commercial divers (EPA 2008c). Accordingly, two different diver exposure scenarios are included in this BHHRA, and are differentiated by considering the use of either a wet suit or dry suit. Each scenario assumes that divers are exposed to sediment and surface water through inadvertent ingestion and dermal contact throughout the Study Area.

3.4.1.4 Transients

Transient encampments are known to exist within the Study Area along the Lower Willamette River. While tents and makeshift dwellings are typically observed above actual beach areas, transients are likely to have direct contact with beach sediment and surface water (including groundwater seeps) during swimming, bathing or other activities, such as washing of clothing or equipment, and may also use surface water as a drinking water source. Although individuals are anticipated to move within or outside the Study Area, some individuals may spend a majority of their time at relatively few areas. Thus, exposure was evaluated as occurring at individual beaches rather than averaged over a larger area. Specific locations where exposure by transients was evaluated in the risk assessment are shown on Map 2-1.

3.4.1.5 Recreational Beach Users

Adults and children participate in recreational activities at beaches within the Study Area, and the LWR is also used for boating, water skiing, swimming, and other activities. The areas currently used for recreational activities as well as other areas in the Study Area where sporadic beach use may occur were identified as recreational use areas. While certain individuals may frequent a specific area almost exclusively, others users may regularly use various areas throughout the Study Area. Recreational activities are likely to result in exposure to beach sediment and surface water.

3.4.1.6 Recreational/Subsistence Fishers

A year-round recreational fishery exists within the Study Area. Current information indicates that spring Chinook salmon, steelhead, Coho salmon, shad, crappie, bass, and white sturgeon are the fish species preferred by local recreational fishers (DEQ 2000b, Hartman 2002, and Steele 2002). In addition to recreational fishing, an investigation by the Oregonian newspaper and limited surveys conducted on other portions of the Willamette River indicate that immigrants from Eastern Europe and Asia, African-Americans, and Hispanics are most likely to use fish from the lower Willamette either as a supplemental or primary dietary source (ATSDR 2002). These surveys also indicate that the most commonly consumed species are carp, bullhead catfish, and smallmouth bass, although other species may also be consumed. In conversations that were conducted as part of a project by the Linnton Community Center (Wagner 2004) about consumption of fish or shellfish from the Willamette River, transients reported consuming a large variety of fish, and several said they ate whatever they could catch themselves or obtain from other fishers.

Direct exposures to beach sediments by individuals engaged in recreational or subsistence fishing was evaluated at specific areas designated as transient and recreational use areas, exposures to in-water sediments were evaluated per half mile along each side of the river as well as on a Study Area-wide basis. Fish consumption was evaluated assuming a single-species diet comprised of each individual target resident fish species (smallmouth bass, black crappie, brown bullhead, and common carp), and based on whether only fillets or the whole fish is consumed. Exposure was evaluated over fishing zones, based on the relative size of the home range for each species, as well as averaged over the entire Study Area. In addition to the individual species diet, a multiple species diet was also evaluated on a harbor-wide basis, assuming each of the four target species comprised equal portions of the total fish consumption. In order to account for a range of cultural consumption practices, both fillet-only and whole body fish consumption were evaluated.

3.4.1.7 Tribal Fishers

The LWR provides a ceremonial and subsistence fishery for Native American tribes. Four Native American tribes (Yakama, Umatilla, Nez Perce, and Warm Springs) participated in a fish consumption survey that was conducted on the reservations of the participating tribes and completed in 1994 [Columbia River Inter-tribal Fish Commission (CRITFC) 1994]. The results of the survey show that tribal members surveyed generally consume more fish than the general public. Certain species, especially salmon and Pacific lamprey, are an important food source as well as an integral part of the tribes' cultural, economic, and spiritual heritage.

3.4.1.8 Domestic Water User

Although there are currently no known uses of the Lower Willamette River as a source of drinking water, public and private use of the Willamette River as a domestic water source is a designated beneficial use by the State of Oregon. Hence, use of surface water as a source of household water was assessed as a potentially complete pathway. Exposure to surface water could occur via ingestion and dermal contact, as well as volatilization of chemicals to indoor air through household use.

3.5 IDENTIFICATION OF EXPOSURE PATHWAYS

Exposure pathways are defined as the physical ways in which chemicals may enter the human body. A complete exposure pathway consists of the following four elements:

- A source of chemical release
- A release or transport mechanism (or media in cases involving media transfer)
- An exposure point (a point of potential human contact with the contaminated exposure medium)
- An exposure route (e.g., ingestion, dermal contact) at the exposure point.

If any of the above elements is missing, the pathway is considered incomplete and exposure does not occur. The potential exposure pathways to human populations at the Study Area include:

- Incidental ingestion of and dermal contact with beach sediment
- Incidental ingestion and dermal contact with in-water sediment
- Incidental ingestion and dermal contact with surface water
- Incidental ingestion and dermal contact with surface water from seeps
- Consumption of fish and shellfish
- Infant consumption of human milk.

A more detailed discussion of potential exposures for the Study Area under current and future conditions, and presents the rationale for including or eliminating pathways from quantitative evaluation. The identified receptors, exposure routes, and exposure pathways, and the rationale for selection are also summarized in Table 3-1.

Exposure pathways are designated in one of the following four ways:

Potentially Complete: There is a source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur. Pathways considered potentially complete are quantitatively evaluated in this BHHRA.

Potentially Complete but Insignificant: There is a source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur. However, exposure via the pathway is likely to be negligible relative to the overall risk. Pathways considered potentially complete but insignificant were not evaluated further in this BHHRA.

Incomplete: There is no source or release from a source, no exposure point where contact can occur, or no exposure route by which contact can occur for the given receptor. Pathways considered potentially incomplete were not evaluated further in this BHHRA.

Potentially complete pathway, but evaluated for a different receptor: These pathways may be complete for some individuals, but are not evaluated for the identified receptor because the pathways are not considered typical for that receptor. These pathways are evaluated for different receptors where the pathways are considered potentially complete and significant. Overlapping exposures that may occur for the different receptors are discussed further in Section 3.3.

The following sections provide a more detailed discussion of the exposure pathways that are quantitatively evaluated in this BHHRA.

3.5.1 Direct Exposure to Beach Sediment

Based on current and future uses within the Study Area, incidental ingestion and dermal contact with beach sediment could occur within natural river beach areas identified as human use areas in the Programmatic Work Plan. These areas were further classified with respect to the type of exposures that could occur, including recreational, fishing, transient, or dockside worker use areas. Human use areas in the Study Area and their associated classifications are shown in Map 2-1. Direct exposure to beach sediments is considered to be a potentially complete pathway for dockside workers, transients, recreational beach users, and both recreational/subsistence and tribal fishers.

3.5.2 Direct Exposure to In-Water Sediment

Direct contact with in-water sediment could occur during activities conducted from a boat or other vessel that result in bringing sediment to the surface, during diving, or when fishing as a result of handling anchors, hooks, or crayfish pots. Hence, direct exposure to in-water sediment is considered to be a potentially complete pathway for in-water workers, divers, recreational/subsistence and tribal fishers. Although recreational beach users may contact in-water sediment while swimming, such exposures are not expected to be significant and were not quantitatively evaluated in the risk assessment. Exposure to in-water sediment was evaluated throughout the Study Area by half-mile river on each side of the river rather than at specific areas as was done with exposure to beach sediments.

3.5.3 Direct Exposure to Surface Water

Direct exposure to contaminants in surface water could occur during recreation or occupational activities that occur near or in the water, or from future use of the LWR as a domestic water source. Transients may also use surface water as a source of drinking water or for bathing. Accordingly, direct exposure via ingestion and dermal contact with surface water is considered to be a potentially complete pathway for transients, recreational beach users, divers, and future domestic water users.

Exposure to contaminants in surface water via dermal absorption and ingestion were considered potentially complete but insignificant pathways for dockside workers, in-water workers, tribal fishers, and fishers. It is unlikely that dockside and in-water workers would have direct contact with surface water on a regular basis, and the potential for significant exposure is considered low while fishing. Additionally, although contaminants may volatilize from surface water to ambientair, it is unlikely to result in a significant exposure considering the amount of mixing with ambient air and the relatively low concentrations of VOCs in surface water. Hence, inhalation of volatiles to ambient air was considered a potentially complete but insignificant exposure pathway for all receptors.

3.5.4 Direct Exposure to Groundwater from Seeps

Direct contact with groundwater is assumed to occur only at seeps where groundwater comes to the surface on a beach above the water line. Direct exposure to groundwater via seeps is considered a potentially complete exposure pathway for transients and recreational beach users. As described in Section 2.1.4, a seep reconnaissance survey identified only Outfall 22B, which is located at approximately RM 7W in an area designated as a potentially used by transients. Therefore, exposure to surface water from the groundwater seep at Outfall 22B was evaluated only for transients.

3.5.5 Consumption of Fish

Many of the contaminants found in Portland Harbor are persistent in the environment and accumulate in the food-chain. Local populations who consume fish caught in Portland Harbor may be exposed to COPCs that bioaccumulate in fish. While the populations evaluated in this BHHRA are described as “fishers,” the fish consumption evaluation in this BHHRA includes people who consume fish caught within the Study Area, not just those who catch the fish. Consumption of locally-caught fish is evaluated as a potentially complete exposure pathway for dockside workers, in-water workers, recreational beach users, and divers. Consumption of fish by these populations is evaluated under the recreational/subsistence receptor. By definition, ongoing long-term fish consumption by transients would not be expected to occur, and the evaluation of fish consumption for other receptors is considered to be protective of consumption of fish by transients.

3.5.6 Consumption of Shellfish

Certain contaminants can bioaccumulate in shellfish, and populations may be exposed to COPCs through consumption of shellfish that are collected within the Study Area. The actual extent shellfish harvesting and consumption is presently occurring is not known. The Linnton Community Center project (Wagner 2004) reported that some transients reported eating clams and crayfish, although many of the individuals indicated that they were in the area temporarily, move from location to location frequently, or have variable diets based on what is easily available. The Superfund Health Investigation and Education (SHINE) program in the Oregon Department of Human Services (DHS) stated that is unknown whether or not crayfish are harvested commercially within Portland Harbor (ATSDR 2006). ODFW has records for crayfish collection in the Columbia and Willamette Rivers, but these records do not indicate whether the collection actually occurs within the Study Area. Based on ODFW’s data for 2005 to 2007, no commercial crayfish landings were reported for the Willamette River in Multnomah County. DHS had previously received information from ODFW indicating that an average of 4,300 pounds of crayfish were harvested commercially from the portion of the Willamette River within Multnomah County each of the five years from 1997-2001. In addition, DHS occasionally receives calls from citizens who are interested in harvesting crayfish from local waters and are interested in fish advisory information. According to a member of the Oregon Bass and Panfish club, traps are placed in the Portland Harbor Superfund Site boundaries and crayfish collected for bait and possibly for consumption (ATSDR 2006). Although consumption of shellfish was considered a potentially complete pathway for dockside workers, in-water workers, recreational beach users, divers, and recreational fishers, it was quantitatively evaluated only for subsistence fishers, as they were considered the most likely population to regularly harvest and consume shellfish.

3.5.7 Infant Consumption of Human Milk

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Lipid-soluble chemicals can accumulate in body fat, including lipids found in breast-milk. As a result, breast-feeding represents a potentially complete exposure pathway for nursing infants. Accordingly, infant exposures to PCBs, dioxins/furans, DDx, and PDBEs were evaluated as a potentially complete exposure pathway wherever maternal exposure to those compounds was evaluated..

3.5.8 Potentially Overlapping Exposure Scenarios

An estimate of reasonable maximum exposure should not only address exposure for individual pathways, but also exposures that may occur across multiple exposure routes. Examples of overlapping scenarios include in-water workers who fish recreationally, and may also be recreational beach users. Potentially overlapping scenarios are indicated on Figure 3-1, and risks from potentially overlapping scenarios are discussed in Section 5.

3.6 CALCULATION OF EXPOSURE POINT CONCENTRATIONS

The exposure point concentration (EPC) is defined as the average concentration contacted at the exposure point(s) over the duration of the exposure period (EPA, 1992a). EPA recommends using the average concentration to represent "a reasonable estimate of the concentration likely to be contacted over time" (EPA 1989). Use of the average concentration also coincides with EPA toxicity criteria, which are based on lifetime average exposures. Because of the uncertainty associated with estimating the true average concentration at a site, EPA guidance (EPA 1989, 1992) notes that the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable. The UCL is defined as a value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true population mean 95 percent of the time. Use of the UCL can also help account for uncertainties that can result from limited sampling data, and more accurately accounts for the uneven spatial distribution of contaminant concentrations. The process to calculate EPCs for tissue and beach sediment was previously described in the Programmatic Work Plan, and Round 1 tissue EPCs were previously presented in *Round 1 Tissue Exposure Point Concentrations* (Kennedy/Jenks Consultants 2004b) and *Salmon, Lamprey, and Sturgeon Tissue Exposure Point Concentrations for Oregon Department of Human Services* (Kennedy/Jenks Consultants 2004c), both of which were approved by EPA. The process for deriving EPCs for in-water sediment, surface water, and groundwater seeps was previously described in *Exposure Point Concentration Calculation Approach and Summary of Exposure Factors* (Kennedy/Jenks Consultants 2006), as approved by EPA.

EPCs for RME evaluations represent either the 95 percent UCL, or the maximum detected value when either there was insufficient data to calculate a UCL or the calculated UCL was greater than the maximum reported value. Although inconsistent with EPA guidance (EPA 1992), EPCs for sediment and surface water CT evaluations were calculated as the simple arithmetic mean because such an evaluation is consistent with OAR 340-122-0084(1)(g) and the primary purpose of the CT evaluations is that they provide bounding information to evaluate uncertainties in the RME evaluation in this risk assessment. EPCs for fish/shellfish consumption scenarios are the lesser of the 95 percent UCL or the maximum detected concentration, central tendency evaluations were achieved by using mean or median consumption rates. For analytes with less than 5 detected concentrations, the maximum detected concentration for that exposure area was used as the EPC for the RME evaluation. The uncertainties associated with estimating EPCs from small datasets and with using the maximum detected concentration as the EPC are discussed in Section 6. The 95 percent UCLs were calculated for each dataset following EPA guidance (EPA 2002a and EPA 2007b). ProUCL version 4.00.02 (EPA 2007b) was used to test datasets for normal, lognormal, or gamma distributions and to calculate the 95 percent UCLs. If the data did not exhibit a discernable distribution, a non-parametric approach was used to generate a UCL. The 95 percent UCLs were calculated using the method recommended by ProUCL guidance (EPA 2007b).

Prior to calculating EPCs, the data were evaluated to address reporting of multiple results for the same analyte in the same sample and to reduce laboratory duplicates and field splits of samples to derive a single value for use. Data reductions performed within the SCRA database followed the rules described in *Guidelines for Data Reporting, Data Averaging, and Treatment of Non-Detected Values for the Round 1 Database Technical Memorandum* (Kennedy/Jenks Consultants et al. 2004). Sample results are reported as not detected when the concentration of the analyte in the sample is less than the detection limit. The actual concentration may be zero, or some value between zero and the detection limit. The following rules were applied to the dataset for tissue, sediment, surface water, and groundwater seep samples:

1. A chemical was assumed to not be present if was not detected in any sample for a given medium within the Study Area, an EPC was not calculated for that chemical in that medium

2. A chemical was presumed to be present if it was detected at least once within the Study Area in samples for a given medium. When calculating the 95 percent UCL, non-detects were used in the calculation as recommended by the ProUCL software. ProUCL software output for the 95 percent UCLs calculated in this BHHRA are provided in Attachment F4. When calculating the simple mean, non-detected values were replaced with one half their detection limit in the calculations.

3. Non-detects for which the detection limit was greater than the maximum detected concentration in an exposure area were removed from the dataset prior to calculating EPCs.

Certain toxicity values are based on exposure to chemical mixtures rather than to individual chemicals, as identified in *Human Health Toxicity Values Interim Deliverable* (Kennedy/Jenks Consultants 2004a). Concentrations of the individual isomers or congeners that comprise the mixtures were summed as described in Section 2.2.8 to calculate the EPCs for the mixtures, and the risks from these chemicals were evaluated on the basis of the combined mixture rather than for individual chemicals.

3.6.1 Beach Sediment

EPCs for beach sediment were calculated using data collected during Rounds 1 and 2 from locations designated as human use areas during Round 1 and 2, beach sediment data was not collected from human use areas during Round 3. One composite sample was collected from each beach area, and the results from each composite sample were was as the EPC for the RME and CT evaluations. When evaluating exposure for dockside workers at industrial sites, the same EPC was used to represent adjacent sites in instances where the beach area extended across individual site boundaries. Otherwise, each designated beach area was evaluated as a single exposure area for transients, recreational beach users, and recreational/subsistence and tribal fishers. Beach sediment exposure areas are presented on Map 2-1, EPCs for dockside workers are presented in Table 3-2, EPCs for transient, recreational, and fishing uses are presented in Table 3-3.

3.6.2 In-Water Sediment

Direct contact with in-water sediment is most likely to occur in the near-shore areas outside of the navigation channel. Thus, only surface sediment data collected less than 30.5 cm in depth and outside of the navigation channel were used to exposure to in-water sediments. In–water sediment EPCs are calculated in one-half mile segments along both sides of the river from RM 1.0 to RM 12.2, and for samples within Multnomah Channel. In-water sediment EPCs for exposures by in-water workers, divers, and recreational/subsistence/tribal fishers are presented in Table 3-4.

3.6.3 Surface Water

Exposure concentrations in surface water were calculated using data collected within the Study Area, as well as the transect data collected from the mouth of Multnomah Channel. Both integrated and non-integrated water column samples were included in the data set, the specific samples used were dependent upon the anticipated exposures by the different receptors.

Surface water exposures by transients may occur throughout the year, EPCs were calculated using data from all seven seasonal sampling events. The data from each of the five transect locations were combined as described in Section 2.2.6. and EPCs were calculated for those five locations, at Willamette Cove using the discrete surface water samples, and on a Study Area-wide basis using the combined transect data from within the Study Area, excluding the transect location W027, which was collected at the mouth of Multnomah Channel. Surface water EPCs for exposures by transients are presented in Table 3-6.

Exposure to surface water by recreational beach users was assumed to occur primarily during summer months. Therefore, only data from the low-water sampling event conducted in July 2005 were used for calculating the surface water EPCs. These data were collected from recreational beaches in July 2005 included three transect locations and three single-point locations (Cathedral Park, Willamette Cove, and Swan Island Lagoon). Surface water EPCs for exposures by recreational beach users are presented in Table 3-7.

Exposures to surface water by divers were assumed to occur throughout the Study Area and were not considered seasonally dependent. EPCs were calculated in one-half mile intervals along each side of the river, and at each transect location. EPCs in surface water for exposures by divers are presented in Table 3-8.

Use of surface water as a domestic water source was assumed to have the potential to occur at any location through the Study Area on a year-round basis. Accordingly, data from all seven seasonal sampling events were used. EPCs were calculated for all individual transect stations and for single point stations with vertically integrated data. In addition, data from locations where co-located near-bottom and near-surface samples were collected were averaged and used in the domestic water dataset. Study Area-wide EPCs included all vertically integrated samples. EPCs for the use of surface water as a domestic water source are presented in Table 3-9.

3.6.4 Groundwater Seeps

As discussed Section 2.1.4, Outfall 22B, which is located on the west side of the river at RM 7, was the only seep identified where direct contact could occur within the Study Area. Data from two sampling events between 2002 and 2007 at times that did not involve stormwater influence were used to calculate the EPC, and the results are presented in Table 3-10.

3.6.5 Fish and Shellfish Tissue

EPCs for fish and shellfish tissue were calculated using data collected in the Round 1, Round 2, and Round 3 investigations, and the ODHS study. EPCs derived from Round 1 data were originally presented in *Round 1 Tissue Exposure Point Concentrations* (Kennedy/Jenks Consultants 2004b). EPCs derived using the results of the ODHS study were originally presented in *Salmon, Lamprey, and Sturgeon Tissue Exposure Point Concentrations for Oregon Department of Human Services* (Kennedy/Jenks Consultants 2004c).

Smallmouth bass were collected and composited over a per river mile. EPCs—whole body and fillet—were calculated for smallmouth bass at each river mile as well as for the entire Study Area consistent with their small home range. Common carp, black crappie, and brown bullhead were collected and composited within river segments designated as fishing zones, which are consistent with the home ranges identified in the Programmatic Work Plan. Fishing zones in Round 1 were designated three-mile segments at RM 3-6 and RM 6-9. Round 3 included additional samples of common carp (but not black crappie or brown bullhead) from three separate four mile long fishing zones that extended over four-mile segments at RM 0-4, RM 4-8, and RM 8-12. EPCs for common carp, black crappie, and brown bullhead were calculated as whole body and fillet for each fishing zone from which they were sampled, as well as for the Study Area.

Adult salmon were collected at the Clackamas fish hatchery, adult lamprey were collected at Willamette Falls, and sturgeon were collected throughout the Study Area. Salmon were analyzed as whole body, fillet with skin, and fillet without skin composite samples. Lamprey were analyzed only as whole body composite samples, sturgeon were analyzed only as fillet without skin composite samples. EPCs were calculated for each species accordingly as average concentrations representative of the entire Study Area.

Crayfish and clams were collected and composited at each sampling location. EPCs for crayfish were calculated for each individual location as well as for the entire Study Area. EPCs for clams were calculated for both depurated and undepurated samples per river mile on each side of the river, as well as for the entire Study Area. EPCs were also calculated for crayfish and clams collected between RM 1.0 and 1.9 and between RM 11.8 and 12.2, per an agreement with EPA.

EPCs for fish tissue are presented in Tables 3-11 through 3-21, and EPCs for shellfish tissue are presented in Tables 3-22 through 3-25.

3.7 ESTIMATION OF CHEMICAL INTAKES

The amount of each chemical incorporated into the body is defined as the dose and is expressed in units of milligrams per kilogram per day (mg/kg-day). The dose is calculated differently when evaluating carcinogenic effects than when evaluating noncarcinogenic effects. Each is described below:

Non-cancer effects: The dose is averaged over the estimated exposure period and is expressed as a chronic daily intake (CDI). Thus, the CDI is used to represent the potential for adverse health effects over the period of exposure.

Carcinogenic effects: The dose is based on the estimated exposure duration, extrapolated over an estimated 70-year lifetime, representing the lifetime average daily intake (LADI) . This is consistent with the cancer slope factors, which are based on lifetime exposures, and on the assumptions that the risk of carcinogenic effects is cumulative and continues even after exposure has ceased.

For non-occupational scenarios where exposures to children are considered likely, both adult and child receptors were evaluated. Children often exhibit behavior such as outdoor play activities and greater hand-to-mouth contact that can result in greater exposure than for a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake. Because cancer risks are averaged over a lifetime, they are directly proportional to the exposure duration as well as the dose and the potency of the chemical. Accordingly, cancer risks were also assessed for a combined exposure from childhood through adult years, to account for the increased relative exposure and susceptibility associated with childhood exposures.

Superfund exposure assessments should be conducted such that the intake variables for an exposure pathway should result in an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions (EPA, 1989). The RME is defined as the highest exposure that is reasonably expected to occur at a site. The intent is to estimate an exposure that is substantially greater than the average, yet is still within the range of possible exposures. In general, this is accomplished by using a combination of 90th or 95th percentile values for contact rate, exposure frequency and duration, and 50th percentile values for other variables. This BHHRA also evaluated central tendency (CT) exposures, which is intended to represent an average exposure by the affected population. Rationale and/or references for each of the RME and CT values for exposure pathways that were quantitatively assessed for each exposure scenario for different populations are presented in exposure factor Tables 3-26 through 3-30 and discussed in the following sections.

3.7.1 Incidental Ingestion of Sediment

The following equation was used to calculate the intake (expressed as milligrams per kilogram per day [mg/kg-day]) associated with the incidental ingestion of contaminants in soil or sediment:

$$CDI\,/\,LADI = \frac{C_s \times IRS \times 10^{-6}\,kg/mg \times EF \times ED}{BW \times AT}$$

Age-weighted exposures for the combined child and adult receptors were calculated consistent with the following equations:

$$CDI\,/\,LADI = \frac{C_s \times IFS_{adj} \times EF \times 10^{-6}\,kg/mg}{AT}$$

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{ED_a \times IRS_a}{BW_a}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
IFS_{adj} = age-adjusted soil/sediment ingestion factor [(mg-year)/(kg-day)]
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)
EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating chemical intake from the ingestion of chemicals in sediment are provided in Tables 3-26 and 3-27.

3.7.2 Dermal Contact with Sediment

The following equation was used to calculate exposure resulting from dermal contact with contaminants in soil or sediment:

$$CDI / LADI = \frac{C_S \times ABS \times SA \times AF \times EF \times ED \times 10^{-6}\, kg/mg}{BW \times AT}$$

Combined child and adult age-weighted exposures resulting from dermal contact with contaminants in sediment for the recreational beach user exposure scenarios were calculated consistent with the following equations:

$$CDI / LADI = \frac{C_S \times SFS_{adj} \times ABS \times EF \times 10^{-6}\, kg/mg}{AT}$$

where:

$$SFS_{adj} = \frac{ED_c \times AF_c \times SA_c}{BW_c} + \frac{ED_a \times AF_a \times SA_a}{BW_a}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
SFS_{adj} = age-adjusted dermal contact factor [(mg-year)/(kg-day)]
ABS = absorption efficiency
SA_a = adult exposed skin surface area (square centimeters [cm^2])
SA_c = child exposed skin surface area (cm^2)
AF_a = adult soil-to-skin adherence factor (mg/cm^2)

AF_c = child soil-to-skin adherence factor (mg/cm^2)
EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating exposure from dermal contact with soil or sediment are provided in Tables 3-26 and 3-27.

Dermal absorption of chemicals from soil or sediment adhered to the skin is dependent on a variety of factors, including the condition of the skin, the nature of adhered soil/sediment, and the chemical concentration. Dermal absorption factors, representing the fraction of a chemical absorbed from soil or sediment adhered to the skin, are presented in Table 3-31. Only those compounds or classes of compounds for which dermal absorption factors are presented were evaluated quantitatively via dermal contact, although assuming less than complete absorption may not fully describe risks associated with dermally active compound such as carcinogenic PAHs. The uncertainties associated with the exposure and risk estimates via dermal exposures with soil and sediments are presented in Section 6.

3.7.2.1 Ingestion of Surface Water

Exposure resulting from ingestion of surface water was evaluated using the following equation:

$$CDI / LADI = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT}$$

Combined child and adult age-weighted exposures due to ingestion of surface water were calculated consistent with the following equations:

$$CDI / LADI = \frac{C_w \times IFW_{adj} \times EF}{AT}$$

where:

$$IFW_{adj} = \frac{ED_c \times IRW_c}{BW_c} + \frac{ED_a \times IRW_a}{BW_a}$$

where:

C_W = chemical concentration in water (mg/L)
IFW_{adj} = age-adjusted water ingestion factor [(L-year)/(kg-day)]
IRW_a = adult groundwater ingestion rate (L/day)
IRW_c = child groundwater ingestion rate (L/day)

EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating chemical intake from the ingestion of groundwater or surface water are provided in Tables 3-28 and 3-30.

3.7.3 Dermal Contact with Surface Water

Dermal absorption of contaminants due to direct contact with surface water was evaluated using the following equation:

$$CDI / LADI = \frac{DA_{event} \times EV \times EF \times ED \times EF \times SA}{AT \times BW}$$

The combined child and adult age-weighted exposure was calculated consistent with the following equations:

$$CDI / LADI = \frac{C_w \times SFW_{adj} \times K_p \times EF \times ET \times CF}{AT}$$

where:

$$SFW_{adj} = \frac{ED_c \times SA_c}{BW_c} + \frac{ED_a \times SA_a}{BW_a}$$

Where:

C_w = chemical concentration in water (mg/L)
DA_{event} = dermally absorbed dose (mg/cm^2-event)
SFW_{adj} = age-adjusted water dermal contact factor [(cm^2-year)/kg]
K_p = dermal permeability coefficient (cm/hour)
EV = events per day
EF = exposure frequency (days/year)
ET = exposure time (hour)
CF = Conversion Factor (0.001 L/cubic centimeter)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
SA_a = adult exposed skin surface area (cm^2)
SA_c = child exposed skin surface area (cm^2)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The absorbed dose per event (DA_{event}) for assessing direct contact with water was calculated using the chemical-specific factors presented in Tables 3-32 and 3-33. These values were obtained from Appendix B of EPA's Supplemental Guidance for Dermal Risk Assessment (2004). The uncertainties associated with calculating DA_{event} for chemicals with factors outside of the predictive domain are discussed in Section 6.

3.7.4 Consumption of Fish/Shellfish

The following equation was used to estimate exposure associated with the consumption of fish and shellfish:

$$CDI / LADI = \frac{C_t \times IR \times 10^{-3}\, kg / g \times EF \times ED}{BW \times AT}$$

Combined child and adult exposure was evaluated consistent with the following equation:

$$CDI / LADI = \frac{C_t \times IR_{t-adj} \times 10^{-3}\, kg / g \times EF}{AT}$$

where:

$$IR_{t-adj} = \frac{ED_c \times IR_c}{BW_c} + \frac{ED_a \times IR_a}{BW_a}$$

where:

C_t = Contaminant concentration in fish tissue (mg/kg, wet-weight basis)
IR_c = Fish consumption rate - child (g/day, wet-weight basis)
IR_a = Fish consumption rate - adult (g/day, wet-weight basis)
EF = Exposure frequency (days/year)
ED_c = Exposure duration – child (years)
ED_a = Exposure duration – adult (years)
BW_c = Body weight – child (kg)
BW_a = Body weight – adult (kg)
AT = Averaging time (days)

The exposure assumptions used to estimate exposure from fish consumption are presented in Table 3-29.

3.7.5 Calculation of Intake due to Infant Consumption of Human Milk

Exposure to breastfeeding infants due to consumption of human milk was evaluated using a methodology developed by ODEQ, OHA, and EPA Region 10, adapted from EPA's Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions (EPA 1998a) and the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 2005a), and is described in detail in Appendix D of the DEQ Human Health Risk Assessment Guidance (DEQ 2010). The evaluation for this pathway focuses on PCBs, dioxins/furans, DDx, and PDBEs because of the propensity of these chemicals to bioaccumulate. Because the concentration of lipophilic chemicals in human milk is most directly correlated with the steady-state body burden, which itself is directly related to the long-term intake of the chemical, the daily maternal absorbed intake is calculated from the average daily dose to the mother (as calculated in the preceding sections) using the following equation:

$$DAI_{maternal} = ADD_{maternal} \times AE$$

where:

$DAI_{maternal}$ = daily absorbed intake of the mother (mg/kg-day)
$ADD_{maternal}$ = age-adjusted soil/sediment ingestion factor (mg/kg-day)
AE = absorption efficiency of the chemical

The steady-state chemical concentration in milk fat is then calculated as:

$$C_{milkfat} = \frac{DAI_{maternal} \times h \times f_f}{ln(2) \times f_{fm}}$$

where:

$C_{milkfat}$ = chemical concentration in milk fat (mg/kg-lipid)
$DAI_{maternal}$ = daily absorbed intake of the mother (mg/kg-day)
h = half-life of chemical (days)
f_f = fraction of absorbed chemical stored in fat
f_{fm} = fraction of mother's weight that is fat

Intake for infants via breastfeeding is then calculated as:

$$Intake = \frac{C_{milkfat} \times f_{mbm} \times CR_{milk} \times ED_{inf}}{BW_{inf} \times AT}$$

where:

f_{mbm} = fraction of fat in breast milk
CR_{milk} = consumption rate of breast milk (kg/day)
ED_{inf} = exposure duration of breastfeeding infant (days)
BW_{inf} = average infant body weight (kg)

AT = averaging time (days)

Additional information regarding the evaluation of persistent, bioaccumulative COPCs is presented in Section 5.1.3.

3.7.6 Calculation of Intake for Mutagenic COPCs

Early-in-life susceptibility to carcinogens has long been recognized by the scientific community as a public health concern. In its revised Cancer Assessment Guidelines, EPA concluded that existing risk assessment approaches did not adequately address the possibility that exposures to a chemical in early life may can result in higher lifetime cancer risks than a comparable duration adult exposure (EPA 2005b). In order to address this increased risk, the agency recommends use of a potency adjustment to account for early-in-life exposures. When no chemical-specific data are available to assess directly cancer susceptibility from early-life exposure, the following default Age Dependent Adjustment Factors (ADAFs) are recommended to be used when evaluating a carcinogen known to cause cancer through a mutagenic mode of action.

- 10-fold adjustment for exposures during the first 2 years of life;
- 3-fold adjustment for exposures from ages 2 to <16 years of age; and
- No adjustment for exposures after turning 16 years of age.

Of the COPCs evaluated in this HHRA, EPA considers that there is sufficient weight-of-evidence to conclude the carcinogenic PAHs cause cancer through a mutagenic mode of action.

3.7.7 Incidental Ingestion of Sediment

The following equation was used to calculate the intake in mg/kg-day for mutagenic COPCs associated with incidental ingestion of soil or sediment:

$$CDI / LADI = \frac{C_s \times \left(\begin{array}{c} \frac{(ED_{0\text{-}2} \times IRS_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRS_c) \times 3}{BW_c} + \\ \frac{(ED_{6\text{-}16} \times IRS_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRS_a) \times 1}{BW_a} \end{array} \right) \times EF}{AT}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)
EF = exposure frequency (days/year)

ED_{0-2} = exposure duration ages 0-2 (years)
ED_{2-6} = exposure duration ages 2-6 (years)
ED_{6-16} = exposure duration ages 6-16 (years)
ED_{16-30} = exposure duration ages 16-30 (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

3.7.8 Dermal Contact with Sediment

The following equation was used to calculate the intake from dermal contact with contaminants in soil or sediment:

$$CDI\ /\ LADI = \frac{C_S \times \left(\begin{array}{c} \dfrac{ED_{0-2} \times AF_c \times SA_c \times 10}{BW_c} + \dfrac{ED_{2-6} \times AF_c \times SA_c \times 3}{BW_c} + \\ \dfrac{ED_{6-16} \times AF_a \times SA_a \times 3}{BW_a} + \dfrac{(ED_{16-30} \times AF_a \times SA_a \times 1}{BW_a} \end{array} \right) \times ABS \times EF \times 10^{-6}\ kg/mg}{AT}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
ABS = absorption efficiency
SA_a = adult exposed skin surface area (square centimeters [cm^2])
SA_c = child exposed skin surface area (cm^2)
AF_a = adult soil-to-skin adherence factor (mg/cm^2)
AF_c = child soil-to-skin adherence factor (mg/cm^2)
EF= = exposure frequency (days/year)
ED_{0-2} = exposure duration ages 0-2 (years)
ED_{2-6} = exposure duration ages 2-6 (years)
ED_{6-16} = exposure duration ages 6-16 (years)
ED_{16-30} = exposure duration ages 16-30 (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

3.7.9 Ingestion of Surface Water

The following equation was used to calculate intake of chemicals associated with ingestion of surface water:

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$$CDI/LADI = \frac{C_w \times \left(\frac{(ED_{0\text{-}2} \times IRW_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRW_c) \times 3}{BW_c} + \frac{(ED_{6\text{-}16} \times IRW_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRW_a) \times 1}{BW_a} \right) \times EF}{AT}$$

where:

C_w	=	chemical concentration in water (mg/L)
IFW_{adj}	=	age-adjusted water ingestion factor [(L-year)/(kg-day)]
IRW_a	=	adult groundwater ingestion rate (L/day)
IRW_c	=	child groundwater ingestion rate (L/day)
EF	=	exposure frequency (days/year)
$ED_{0\text{-}2}$	=	exposure duration ages 0-2 (years)
$ED_{2\text{-}6}$	=	exposure duration ages 2-6 (years)
$ED_{6\text{-}16}$	=	exposure duration ages 6-16 (years)
$ED_{16\text{-}30}$	=	exposure duration ages 16-30 (years)
BW_a	=	adult body weight (kg)
BW_c	=	child body weight (kg)
AT	=	averaging time (days)

The exposure parameters are presented in Tables 3-26 to 3-30.

3.7.10 Population-Specific Exposure Assumptions

Assumptions about each receptor population evaluated in this BHHRA were used to select exposure parameters used to calculate the pathway-specific chemical intakes. Site-specific values are not available for all populations and pathways. Therefore, default values representative of the general U.S. population (EPA 1991b) or values representing best professional judgment based on known human uses of the Study Area were used. The majority of the exposure parameters used in this BHHRA were previously described in the *Exposure Point Concentration Calculation Approach and Summary of Exposure Factors* (Kennedy/Jenks Consultants 2006), which was approved by EPA. Exposure parameters for divers were provided by EPA in its comments on the Round 2 Report. The exposure parameters are discussed below and presented in Tables 3-26 to 3-30. These values represent potential exposures for application at appropriate areas and/or areas agreed upon with EPA and its partners within the Study Area.

3.7.10.1 Dockside Workers

Exposure frequency for dockside workers was assumed to be 50 days/year for the RME evaluation, and 40 days/year the CT evaluation. An exposure duration of 25 years was used, representing an EPA default value for the RME estimate of job tenure. This value is consistent with data from the U.S. Bureau of Labor Statistics showing that the 95th percentile job tenure for men in the manufacturing sector is 25 years. The CT estimate assumed duration of 9 years, representing approximately the 50th percentile of residence time estimates from the U.S. Census Bureau data (EPA, 1997).

A sediment ingestion rate of 200 mg/day was used for the RME evaluation, based on EPA Region 10 supplemental guidance on soil ingestion rates (EPA, 2000a), and is representative of approximately the midpoint between the recommended values of 100 mg/day for outdoor workers and 330 mg/day for construction workers. An ingestion rate of 50 mg/day was used to estimate CT exposure.

Dermal exposure was assessed assuming that the face, forearms and hands are exposed, representing an exposed skin surface area of 3,300 cm^2, which is representative of the median value (50th percentile) for adults. A body weight of 70 kg, representing the 50th percentile of mean body weights of men and women combined (EPA, 1997a) was used for all adult receptors. RME and CT exposure values for dockside workers are presented in Table 3-26.

3.7.10.2 In-Water Workers

According to the Army Corps of Engineers (Siipola 2004), the Port of Portland conducts the most frequent dredging within the Study Area, thus the exposure factors for workers at Terminal 4 are considered protective of in-water workers for potential in-water sediment exposures throughout the Study Area. Exposure factors for in-water workers were developed based on in-depth interviews with several workers at Terminal 4 who either conduct or oversee activities that could result in contact with in-water sediment. For the RME evaluation, in-water sediment exposures were assumed to occur for 10 of 25 years of employment at a given facility, with an exposure frequency of 10 days of sediment contact per year. For the CT evaluation, contact with in-water sediment is assumed for 4 of 9 years employment at a given facility, with an exposure frequency of 10 days of sediment contact per year. Intake rates for in-water sediment are the same as those used for the dockside worker, which are the default ingestion rate of soil for an industrial worker. RME and CT exposure values for the in-water worker are presented in Table 3-27.

3.7.10.3 Divers

Two different scenarios were evaluated, based on whether the divers wear wet or dry suits. Divers wearing wet suits are assumed to be working as commercial divers without a full face mask, and wearing either wet gloves or no gloves. An exposure frequency of 5 days/year for the RME evaluation and 2 days/year for the CT evaluation are based on best professional judgment and discussions between EPA, LWG, and commercial divers, as well as the experience of EPA divers who work at the Portland Harbor Superfund site. Exposure durations of 25 years and 9 years were used for the RME and CT estimates, respectively, based on the labor statistics for job tenure described in Section 3.5.9.1.

Sediment ingestion rates were assumed to be 50 percent of the ingestion rate for dockside workers, corresponding to values of 50 mg/day and 25 mg/day, respectively for the RME and CT evaluations. Dermal exposure to sediment for divers wearing a wet suit was evaluated assuming the entire skin surface area was exposed. A value of 18,150 cm^2, representing the median skin surface area for men and women was used for both the RME and CT evaluations. Divers wearing a dry suit (with a neck dam) would likely have only their head, neck, and hands exposure, and a RME value of 2,510 cm^2 was used. Sediment dermal adherence factors for of 0.3 mg/cm^2-event and 0.07 mg/cm^2 event was used for the was used for the RME estimate and CT estimate, respectively. A CT evaluation was not done for divers wearing dry suits.

Incidental ingestion of surface water for both diver scenarios was assumed to be 50 mL/hour for both the RME and CT evaluations (EPA 1989). More recent data regarding estimates of the amount of water ingested by commercial divers indicates that on average, occupational divers ingested 6 mL/dive in freshwater and 10 mL/dive in marine water, with the maximum estimated ingestion ranging between 25 and 100/mL/dive (EPA 2011). Exposure via ingestion and dermal contact was assumed to occur for 4 hours/event for the RME estimate and 2 hours/event for the CT estimate.

Tables 3-27 and 3-28 summarize exposure assumptions for the wet suit and dry suit divers for in-water sediment and surface water, respectively.

3.7.10.4 Transients

Little information is available regarding how long individuals may remain at specific locations or within the Study Area itself. Based on professional judgment, an exposure duration of 2 years was assumed for the RME and 1 year for CT evaluations, exposure frequency was assumed to be daily (365 days/year). Incidental ingestion of sediment was evaluated at the same rates used for the dockside workers (200 mg/day). Dermal exposure was assessed assuming that the face, forearms and hands, and lower legs are exposed, representing an exposed skin surface area of 5,700 cm^2, which represents the median value for adults. A soil adherence factor of 0.3 mg/cm^2 was used based on the expectation that beach sediment would have a greater moisture content than dry soil. An ingestion rate of 2 L/day was used for consumption of surface water, which represents the default value for domestic water use. Tables 3-26 and 3-28 summarize RME and CT exposure values for the transient scenario for beach sediment and surface water, and the reference and rationale for each value.

3.7.10.5 Recreational Beach User

In the absence of specific information regarding the frequency of recreational activities in Portland Harbor, potential exposures are based on best professional judgment, assuming that beach use is most frequent in the summer, with less frequent use in the spring/fall, and only intermittent use in the winter. An exposure frequency of 94 days/year (5 days/week during summer, 1 day/week during spring/fall, and 1 day/month during winter) was used for the RME estimate and 38 days/year

(2 days/week during summer, 2 days/month during spring/fall) was used for the CT estimate. Exposure duration for recreational activities is based on the assumption that individuals are largely permanent residents of the Portland area. Accordingly, an exposure duration of 30 years, which represents approximately the 95th percentile of the length of continuous residence in a single location in the U.S. population (EPA 1997) was used for the RME estimate. More recent studies described in the 2011 edition of EPA's Exposure Factors Handbook show the 95th percentile value is closer to 33 years, data from the U.S. Census Bureau indicate that 32 years represents the best estimate of residence time at the 90th percentile. However, the value of 30 years is consistent with other Superfund risk assessments nationwide, and represents a reasonably conservative estimate of total residence time in the area. An exposure duration of 9 years was used for the CT estimate.

Sediment ingestion rates of 100 mg/day for adults and 200 mg/day for children were used, approximating the 95th percentile soil ingestion rates. CT estimates assumed sediment ingestion rates of 100 mg/day for children and 50 mg/day for adults. Dermal exposures were evaluated assuming that the face, forearms and hands, and lower legs are exposed. Median values of 5,700 cm^2 and 2,800 cm^2 were used for adults and children, respectively. A soil-skin adherence of 3.3 mg/cm^2-day was used for children to account for the greater moisture content of beach sediment.

Water temperatures in the Lower Willamette River would typically limit swimming to the summer months, thus swimming was assumed to occur at a rate of 26 days per year. As discussed in Section 3.5.10.3, incidental ingestion of river water was assumed to occur at a rate of 50 mL/hour while swimming. Based on current recommendations, 50 mL/hr represents mean value, assuming 21mL/hr for adults and 49 mL/hr for children, upper-percentile recommended values are 71 mL/hr for adults and 121 mL/hr for children(EPA 2011). Tables 3-26 and 3-28 summarize RME and CT exposure values for beach sediment and surface water, respectively, for adult and child recreational beach users.

3.7.10.6 Recreational/Subsistence Fishers

Because there is limited information regarding the frequency of fishing activities within the Study Area, a range of possible exposures was evaluated for people who engage in recreational or subsistence fishing activities by considering both a high- and a low-frequency rate of fishing. RME estimates for high-frequency (subsistence) fishers assumed a fishing frequency of 156 days/year, approximating a rate of 3 days/week. Low-frequency (recreational) fishers were assumed to fish 104 days/year, approximating a rate of 2 days/week. CT estimates assumed a frequency of 52 days/year and 26 days/year for high- and low-frequency fishers, respectively, and are representative of assumed fishing frequencies of 1 day/week and 2 days/month. People engaged in recreational or subsistence fishing were also assumed to be residents of the greater Portland area, therefore exposure durations of 30 years and

9 years, were used for the RME and CT evaluations, respectively, based on the population statistics for residency discussed in Section 3.5.9.5.

Incidental ingestion of beach sediment was evaluated assuming 100 mg/day for the RME estimate and 50 mg/day for the CT estimate, representative of soil ingestion rates in a typical residential setting. Rates of 50 mg/day for the RME estimate and 25 mg/day for the CT estimate were used for incidental ingestion of in-water sediment, representing 50 percent of the rates used for beach sediment. An exposed surface area of 5,700 cm^2, representing the face, hands, forearms and lower legs was used to assess dermal exposure to beach sediments, exposures to in-water sediment was assumed to be limited to the hands and forearms, corresponding to a surface area of 1,980 cm^2. Sediment adherence to skin was evaluated using a weighted adherence factor based on exposure to the hands, forearms, and lower legs (EPA 2004). A factor of 25 percent was used to account for the time spent fishing in a single area within the Study Area. Exposure assumptions for beach and in-water sediment contact for recreational/subsistence fishers are presented in Tables 3-26 and 3-27

Information currently available indicates that spring Chinook salmon, steelhead, Coho salmon, shad, crappie, bass, and white sturgeon are the fish species preferred by local recreational fishers (DEQ 2000b, Hartman 2002, and Steele 2002). In addition to recreational fishing, an investigation by the Oregonian newspaper and limited surveys conducted on other portions of the Willamette River indicate that immigrants from Eastern Europe and Asia, African-Americans, and Hispanics are most likely to be catching and eating fish from the lower Willamette either as a supplemental or primary dietary source (ATSDR 2002). These surveys also indicate that the most commonly consumed species are carp, bullhead, catfish, and smallmouth bass, although other species may also be consumed. In conversations that were conducted as part of a project by the Linnton Community Center (Wagner 2004) about consumption of fish or shellfish from the Willamette River, transients reported consuming a large variety of fish, and several said they ate whatever they could catch themselves or obtain from other fishers.

No studies were located that document specific consumption rates of recreational or subsistence anglers in Portland Harbor prior to its listing as a Superfund site. Surveys conducted subsequent to the listing would not be representative of historical, baseline consumption patterns due to subsequent fish advisories and efforts to limit consumption of fish caught from the harbor. Therefore, fish consumption rates from published studies were used to describe the range of reasonably expected exposures relevant to the different populations known to occur in the Portland Harbor area. Three different rates were evaluated: 17.5 grams per day (approximately 2 eight ounce meals per month), 73 g/ day (10 eight ounce meals per month), and 142 g/day per day (19 eight ounce meals per month). The term "recreational fishers" is intended to encompass a range of the population while focusing on those who may fish on a more-or-less regular basis, and "subsistence fishers" to represent populations with high fish consumption rates, recognizing that fish are not an exclusive source of

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protein in their diet. Accordingly, 17.5 g/day is considered representative of a CT value for recreational fishers, and 73 g/day was selected as the RME value representing the higher-end consumption practices of recreational fishers. The consumption rate of 142 g/day represents a RME value for high fish consuming, or subsistence, fishers. No CT value was selected because the evaluations based on 17.5 g/day and 73 g/day inform the risks associated with lower consumption rates. Consumption rates for children aged 6 years and younger were calculated by assuming that their rate of fish consumption is approximately 42 percent of an adult, based on the ratio of child-to-adult consumption rates presented in the CRITFC Fish Consumption Survey (CRITFC 1994). The corresponding rates that were used for children are 7 g/day, 31 g/day, and 60 g/day.

The rates of 17.5 g/day and 142 g/day represent the 90th and 99th percentiles, respectively, of per capita consumption of uncooked freshwater/estuarine finfish and shellfish by individuals (consumers and non-consumers) 18 or older, as reported in the Continuing Survey of Food Intakes by Individuals (CSFII) and described in EPA's Estimated Per Capita Fish Consumption in the United States (EPA 2002b). While the values are presented in terms of "uncooked weight," it should not be construed to imply that the fish are consumed raw, as the consumption rates represent adjusted values to account for the amount of fish needed to prepare specific meals. No adjustments were made to contaminant concentrations in raw fish tissue because of the uncertainties associated with accounting for specific preparation and cooking practices.

The CSFII surveys recorded food consumption for two non-consecutive days. "Consumers only" were defined as individuals who ate fish at least once during the 2-day reporting period, individuals who reported not consuming any fish during the reporting period were designated as "non-consumers." For comparison, the 90th and 99th percentile consumption rates for consumers-only are 200 g/day and 506 g/day, respectively (EPA 2002b). Because of the short time period over which the survey is conducted, the results characterize the empirical distribution of average daily per capita consumption rather than describe true long-term average daily intakes. Although 17.5 g/day represents a 90th percentile value, it is considered an average consumption rate for sport fishers (EPA 2000d). Similarly, 142 g/day is considered to be representative of average consumption estimates for subsistence fishers when compared to upper percentile values for consumers only. However, the use of values representative of both non-consumers and consumers is appropriate as it accounts for the fact that some portion of the total diet of fish consumed may come from sources other than Portland Harbor. The consumption rate of 73 g/day is from a creel study conducted in the Columbia Slough, and represents the 95 percent upper confidence limit on the mean, where 75 percent of the mass of the total fish is consumed (Adolfson 1996).

Consumption of shellfish was evaluated considering only consumption by adults, and assuming that consumption of shellfish is primarily a component of a subsistence diet. Site-specific information regarding consumption of shellfish is not available, thus a range of consumption rates were evaluated. Consumption rates of 3.3 g/day and 18 g/day were selected as representative of CT and RME estimates These values represent the 50th and 95th percentile consumption rates of shellfish from freshwater and estuarine systems for individuals of age 18 and older in the United States (EPA 2002b). Exposure assumptions for recreational/subsistence fish consumption are presented in Table 3-29, and the uncertainties associated with these consumption rates are discussed in Section 6.

3.7.10.7 Tribal Fishers

Specific information regarding population mobility on Native American populations is less readily available than for the general U.S. population. The evaluation of exposures to Native Americans was based on the premise that they spend their entire lives in the area (EPA 2005c), and a typical lifetime was evaluated as 70 years. Fishing frequency was assumed to be 260 days/yr (5 days/week) for the RME estimate and 104 days/year (2 days/week) for the CT estimate.

Incidental ingestion of beach sediment was evaluated assuming 100 mg/day for the RME estimate and 50 mg/day for the CT estimate. Rates of 50 mg/day for the RME estimate and 25 mg/day for the CT estimate were used for incidental ingestion of in-water sediment, representing 50 percent of the rates used for incidental soil ingestion in a typical residential setting. An exposed surface area of 5,700 cm^2, representing the face, hands, forearms and lower legs was used to assess dermal exposure to beach sediments, exposures to in-water sediment was assumed to be limited to the hands and forearms, corresponding to a surface area of 1,980 cm^2. Sediment adherence to skin was evaluated using a weighted adherence factor based on exposure to the hands, forearms, and lower legs (EPA 2004). A factor of 25 percent was used to account for the time spent fishing in a single area within the Study Area. Exposure assumptions for beach and in-water sediment contact for tribal fishers are presented in Tables 3-26 and 3-27.

Fish consumption by tribal members was evaluated assuming a multi-species diet that includes both resident and anadromous fish (salmon, lamprey, and sturgeon). An overall rate of 175 g/day (approximately 23 eight oz meals per month), representing the 95th percentile of consumption rates for consumers and non-consumers in the CRITFC Survey was used for adult tribal fish consumers. A consumption rate of 73 g/day, representing the 95th percentile of consumption for children from the CRITFC Survey was used for child tribal fish consumers. The CRITFC survey reported that none of the respondents fished the Willamette River for resident fish, and approximately 4 percent fished for anadromous fish. Overall fish consumption information from the CRITFC survey was used to determine the ingestion rate for each fish species, as shown below:

Species	Grams per day[(a)]	Percent of diet

Salmon	67	38.4
Lamprey	12.3	7.0
Sturgeon	8.6	4.9
Smelt	12.5	7.2
Whitefish	23.2	13.3
Trout	25.1	14.3
Walleye	9.9	5.7
Northern Pikeminnow-	3.7-	2.1
Sucker	7.3	4.2
Shad	5.2	3.0
Total Consumption Rate	175	100

(a) Rates are based on the weighted mean data in Table 18 of CRITFC 1994.

As shown, consumption rates of anadromous species account for approximately 50 percent of total intake. Consumption of salmon, lamprey and sturgeon were evaluated at rates of 38.4 g/day, 7 g/day, and 4.9 g/day, respectively. The remaining portion of the diet was evaluated assuming equal portions of the four resident fish (smallmouth bass, brown bullhead, common carp, and black crappie) for which tissue data were available. Consumption rates for children were calculated using the same dietary percentages as the adult tribal fish consumers and a total intake of 73 g/day. Exposure assumptions for tribal fish consumption are presented in Table 3-29. Adult salmon, adult lamprey, and sturgeon have life histories such that significant contaminant loading can occur outside of the Study Area, making it problematic to associate tissue concentrations with site contamination. However, including consumption of anadromous fish in conjunction with resident fish provides useful information regarding risks to tribal members who may fish the Lower Willamette River.

3.7.10.8 Domestic/Household Water User

Use of surface water as a household water source was evaluated assuming exposure occurs in a residential setting. Exposure frequency is assumed as 350 days per year (7 days/week for 50 weeks) for both the RME and CT evaluations. As discussed in Section 3.5.9.5, overall exposure duration for residential exposure was assessed as 30 years for the RME estimate and 9 years for the CT estimate. Water ingestion by adults was evaluated at a rate of 2 L/day for the RME estimate, representing the average of the 90th percentiles of two national studies (EPA 1997a). A value of 1.4 L/day was used for the CT estimate, representing the population-weighted means of the same studies. These values are representative of water consumed directly from the tap or used in the preparation of food and beverages for adults. Ingestion rates representing 50th percentile values of 1.4 L/day for RME and 0.9 L/day for CT were used for children aged 6 years and younger.

Dermal exposures during showering or bathing were evaluated assuming a rate of one event per day, with an event duration of 35 minutes (0.58 hr) for the RME and 15 minutes (0.15 hr) for the CT, representing the 95th and 50th percentile values from

EPA 1997a. A total skin surface area of 18,000 cm^2, representing estimates of the 50^{th} percentile of mean surface area for adult men and women (EPA 1997a), was used for both the RME and CT estimates. A corresponding mean surface area of 6,600 cm^2 was used for children aged 6 years and younger.

Table 3-30 summarizes the exposure assumptions used to evaluate domestic use of surface water.

3.7.11 Chemical-Specific Exposure Factors and Assumptions

In calculating chemical intakes, certain assumptions were made that were specific to a given chemical or class of chemicals. These chemical-specific assumptions had an effect on both EPCs and intake calculations, and are described below.

3.7.11.1 Arsenic

Although arsenic was analyzed as total arsenic, the toxicity values represent inorganic arsenic. In previous fish tissue studies in the lower Columbia and Willamette Rivers, the percent of inorganic arsenic relative to total arsenic ranged from 0.1 percent to 26.6 percent with an average of 5.3 percent inorganic arsenic in resident fish samples from the Willamette River (Tetra Tech 1995, EVS 2000). Shellfish may have a higher percentage of inorganic arsenic, as measured in studies on the Lower Duwamish River. The Columbia River Basin Fish Contaminant Survey (EPA 2002c) concluded that a "value of 10 percent is expected to result in a health protective estimate of the potential health effects from arsenic in fish." Therefore, 10 percent of total arsenic in tissue was assumed to be inorganic arsenic when calculating. Uncertainties associated with the assumption that 10 percent of the total arsenic is in the inorganic form in fish and shellfish are discussed further in Section 6.

3.7.11.2 PCBs

PCBs were analyzed as Aroclors and congeners in tissue. Where PCBs were analyzed as Aroclors, the summed concentration of individual Aroclors was used in calculating the EPCs. Where PCBs were analyzed as congeners, EPCs were calculated using both the total PCB value (sum of individual congeners) and an adjusted total PCB value. The adjusted total PCB value was calculated by subtracting the concentration of the coplanar PCB congeners from the total PCB concentration. This was done because the coplanar PCB congeners were evaluated separately (as TCDD toxic equivalents [TEQs]) for cancer risks. Further explanation of how PCB congeners were summed is provided in as described in Section 2.2.8.

3.7.11.3 Oral Bioavailability Factors for Sediment

Consistent with EPA guidance (1989), the chemical intake equations calculate the amount of chemical at the human exchange boundaries, not the amount of chemical available for absorption. Therefore, the estimated intakes calculated in this BHHRA are not the same as the absorbed dose of a chemical. However, the toxicity of an ingested chemical depends on the degree to which the chemical is absorbed from the gastrointestinal tract into the body. Per EPA guidance (1989, 2007c), if the exposure medium in the risk assessment differs from the exposure medium assumed by the toxicity value, an adjustment for bioavailability may be appropriate. For purposes of this BHHRA, oral bioavailability factors were not used to adjust the estimated exposures from COPCs in sediment. The uncertainties associated with not considering bioavailability in this BHHRA are discussed in Section 6.

4.0 TOXICITY ASSESSMENT

The toxicity assessment is composed of two steps: (1) hazard identification and (2) dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical may result in a deleterious health effect in humans. It consists of characterizing the nature of the effect and the strength of the evidence that the chemical will cause the observed effect. Dose-response assessment characterizes the relationship between the dose and the incidence and/or severity of the adverse health effect in the exposed population. For risk assessment purposes, chemicals are generally separated into categories based on their toxicological endpoints. The primary basis of this categorization is whether a chemical exhibits potentially carcinogenic or noncarcinogenic health effects. Because chemicals that are suspected carcinogens may also give rise to noncarcinogenic effects, they must be evaluated separately for both effects.

4.1 TOXICITY VALUES FOR EVALUATING CARCINOGENIC EFFECTS

Cancer slope factors are used to estimate the risk of cancer associated with exposure to a chemical known or suspected to be carcinogenic. The slope factor is derived from either human epidemiological or animal studies, and represents an upper bound, generally approximating a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure by ingestion. Slope factors are generally expressed in units of proportion (of a population) affected per mg of substance/kg body weight-day ([(mg/kg-day)$^{-1}$].

In addition to the numerical estimates of carcinogenic potential, a cancer weight-of-evidence (WOE) descriptor is used to describe a substance's potential to cause cancer in humans and the conditions under which the carcinogenic effects may be expressed. This judgment is independent of consideration of the agent's carcinogenic potency. Under EPA's 1986 guidelines for carcinogen risk assessment, the WOE was described by categories "A through E"—Group A for known human carcinogens through Group E for agents with evidence of noncarcinogenicity. Under EPA's 2005 guidelines for carcinogen risk assessment, a narrative approach rather than the alphanumeric categories is used to characterize carcinogenicity. Five standard weight-of-evidence descriptors are used: *Carcinogenic to Humans, Likely to Be Carcinogenic to Humans, Suggestive Evidence of Carcinogenic Potential, Inadequate Information to Assess Carcinogenic Potential, and Not Likely to Be Carcinogenic to Humans).* Slope factors for assessing dermal exposure were derived as described in Section 4.7, and oral and dermal slope factors are presented in Table 4-1.

4.2 TOXICITY VALUES FOR EVALUATING NONCARCINOGENIC EFFECTS

The reference dose (RfD) provides quantitative information for use in risk assessments for health effects known or assumed to be produced through a nonlinear (possibly threshold) mode of action. The RfD, expressed in units of mg of substance/kg body weight-day (mg/kg-day) is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The use of RfDs is based on the concept that there is range of exposures that exist up to a finite value, or threshold, that can be tolerated without producing a toxic effect. Reference doses are presented in Table 4-2.

4.3 SOURCES OF TOXICITY VALUES

The following hierarchy of sources of toxicity values is currently recommended for use at Superfund sites (EPA 2003b):

- Tier 1 – EPA's Integrated Risk Information System (IRIS) database (EPA 2010b) is the preferred source of information because it normally represents the official EPA scientific position regarding the toxicity of the chemicals based on the data available at the time of the review. IRIS contains RfDs and cancer slope factor (SFs) that have gone through a peer review and EPA consensus review.
- Tier 2 - EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) are toxicity values derived for use in the Superfund Program when such values are not available in IRIS. PPRTVs are derived after a review of the relevant scientific literature using the methods, sources of data and guidance for value derivation used by the EPA IRIS Program. The PPRTV database includes RfDs and SFs that have undergone internal and external peer review. The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 - Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority is given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Tier 3 sources may include, but need not be limited to, the following sources:
  - The California Environmental Protection Agency (Cal EPA) Toxicity Criteria Database (Cal EPA 2008) includes toxicity values that have been peer reviewed.
  - The ATSDR Minimal Risk Levels are similar to RfDs and are peer reviewed.

– Health Effects Assessment Summary Table (HEAST) toxicity values are currently under review by the STSC to derive PPRTVs. The toxicity values remaining in HEAST are considered Tier 3 values.

Trichloroethylene cancer potency was evaluated using the geometric mid-point of the slope factor range from EPA 2001b as recommended by EPA Region 10 (EPA 2007b). Recommendations were not provided for evaluating oral exposures for noncancer endpoints for trichloroethylene.

4.4 CHEMICALS WITH SURROGATE TOXICITY VALUES

If a toxicity value was not available from the above hierarchy for a specific chemical, a structurally similar chemical was identified as a surrogate. The reference dose or slope factor for the surrogate chemical was selected as the toxicity value and the surrogate chemical was indicated in Tables 4-1 and 4-2. The following chemicals were evaluated using surrogate toxicity criteria:

- Butyltin. The toxicity of organotin compounds is somewhat determined by the nature and number of groups bound to tin. In general, toxicity decreases as the number of linear carbons increases and as the number of substitutions decrease. As a health protective approach, RfD for dibutyltin compounds was selected as a surrogate for butyltin.

- Acenaphthylene is classified as category D (not classifiable as to human carcinogenicity). The RfD for acenaphthene, which is the most structurally similar PAH, was selected as a surrogate for acenaphthylene.

- Benzo(e)pyrene. As a health protective approach, the RfD for pyrene was used as a surrogate for benzo(e)pyrene.

- Benzo(g,h,i)perylene is classified as category D (not classifiable as to human carcinogenicity). As with benzo(e)pyrene, the RfD for pyrene was used as a surrogate for benzo(g,h,i)perylene.

- Dibenzothiophene. Fluorene the most structurally similar PAH with available toxicity values. Hence, the RfD for fluorene was used as a surrogate for dibenzothiophene.

- Dibenzofuran. The RfD for flourene, which represents the most structurally similar compound for which an RfD was available was selected as a surrogate for dibenzofuran.

- Di-n-octyl phthalate. The RfD for dibutyl phthalate was selected as a surrogate for di-n-octyl phthalate.

- Perylene. The RfD for pyrene was selected as a surrogate for perylene.
- Phenanthrene. The RfD for pyrene was selected as a surrogate for phenanthrene.
- Retene. The RfD for pyrene was selected as a surrogate for retene.
- Endrin aldehyde. Endrin aldehyde can occur as an impurity of endrin or as a degradation product (ATSDR 1996). The RfD for endrin was used as a surrogate for endrin aldehyde.
- Endrin ketone. Endrin ketone can occur as an impurity of endrin or as a degradation product (ATSDR 1996). The RfD for endrin was used as a surrogate for endrin ketone.
- 4-Nitrophenol. The RfD for 4-methylphenol was used as a surrogate for 4-nitrophenol.

4.5 CHEMICALS WITHOUT TOXICITY VALUES

No SF and RfD or other suitable surrogate values were obtained for titanium and delta-hexachlorocyclohexane (delta-HCH). Titanium is a naturally occurring element and has been characterized as having extremely low toxicity (Friberg et al. 1986). An STSC review concluded that the other hexachlorocyclohexane isomers could not be used as surrogates for delta-HCH due to differences in toxicity (EPA). Accordingly, the potential risks from titanium and delta-HCH are discussed qualitatively in the uncertainty assessment in Section 6.

SFs and RfDs were not identified for lead because lead was evaluated through comparison with benchmark concentrations that are based on blood lead levels. Benchmark concentrations for child exposure scenarios were predicted by the Integrated Exposure Uptake Biokinetic (IEUBK) model. Benchmark concentrations for adult exposure scenarios were predicted by the Adult Lead Methodology (ALM). Uncertainties associated with using these benchmark concentrations are discussed in Section 6.4.4.

4.6 TOXICITY VALUES FOR CHEMICAL CLASSES

Certain toxicity values are based on exposure to more than one isomer and not to individual chemicals. As a result, the risks were evaluated for the combined exposure rather than on an individual chemical basis. COPCs that were evaluated for toxicity as classes are indicated in Tables 4-1 and 4-2, and are discussed below.

- Chlordane: The chlordane toxicity values were derived for technical chlordane, which is composed of a mixture of chlordane isomers. The chlordane isomers analyzed in Round 1, Round 2, and Round 3 samples were alpha-chlordane, *trans*-chlordane, *cis*-nonachlor, *trans*-nonachlor, and oxychlordane. These isomers were summed in a total chlordane concentration. The SF and RfD for technical chlordane were used to evaluate total chlordane.

- DDD, DDE, and DDT: Technical DDT includes 2,4'-DDT and 4,4'-DDT, as well as 2,4'-DDE, 4,4'-DDE, 2,4'-DDD, and 4,4'-DDD. Although individual slope factors are available for DDD, DDE, and DDT based on studies conducted using the 4,4' isomers, the potency of the 2,4' isomers was assumed to be equal to that of the 4,4' isomers, and cancer risks assessed as the sum of the 2,4' and 4,4' isomers. Additionally, the RfD for DDT was used as a surrogate to evaluate the noncancer effects of DDD and DDE.

- Endosulfan: The RfD for endosulfan was derived from studies using technical endosulfan, which includes alpha-endosulfan, beta-endosulfan, and endosulfan sulfate. The individual endosulfan results were summed to give a total endosulfan concentration, and the RfD for technical endosulfan was used to evaluate total endosulfan.

- PCBs: The cancer slope factor for PCBs is based on administered doses of Aroclors (Aroclor 1016, 1242, 1254, or 1260), and was used to assess the cancer risks for total PCBs measured either as congeners or Aroclors. As discussed in Section 2.2.8, total PCB concentrations were calculated as either the sum of Aroclors or individual congeners. Where PCBs were reported as individual congeners, an adjusted PCB concentration was calculated by subtracting the sum of total dioxin-like PCB congener concentrations from the sum of all congeners. Dioxin-like PCB congeners were evaluated separately using the slope factor for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) as described below. This approach may double-count a portion of the toxicity of the dioxin-like PCBs, as discussed in Section 6.3.6. The RfD for Aroclor 1254 was used to evaluate the noncancer endpoint for total PCBs, measured either as total unadjusted congeners or as Aroclors.

- Dioxins and furans: Toxic Equivalency Factors (TEFs) from the World Health Organization (WHO) (Van den Berg 2006) were used to evaluate carcinogenic effects of dioxin and furan congeners and for dioxin-like PCB congeners (see Table 4-3). Concentrations of individual congeners are multiplied by their respective TEF to provide a 2,3,7,8-TCDD-equivalant concentration (TEQ), the resulting TEQs are then summed into a total 2,3,7,8-TCDD TEQ. Cancer risk were assessed using the slope factor for 2,3,7,8-TCDD was used to evaluate the cancer endpoint of the TEQ for dioxin and furan congeners, as well as for dioxin-like PCB congeners. The ATSDR

MRL for 2,3,7,8-TCDD was used in conjunction with the TEQ approach for dioxin and furan congeners, and for dioxin-like PCB congeners.

- Carcinogenic PAHs: Individual carcinogenic PAHs were evaluated for toxicity based on their potency equivalency factor (PEF), which estimates cancer potency relative to benzo(a)pyrene (EPA 1993). The toxicity values for individual PAHs shown in Table 4-1 incorporate their respective PEFs. Risk from both individual and total carcinogenic PAHs was assessed in this BHHRA.

4.7 DERMAL ASSESSMENT

Toxicity is a function of contaminant concentration at critical sites-of-action. However, most oral reference doses and slope factors are expressed as an administered dose, whereas exposure estimates for dermal exposures are based on the absorbed dose. Anatomical differences between the gastrointestinal tract and the skin can affect rate as well as the extent of absorption. Thus, the route of exposure may significantly affect the critical dose at the site-of-action. A further complication is that an orally administered dose experiences "hepatic first-pass" metabolism, which may significantly alter the toxicity of the administered chemical. Additionally, some chemicals can cause cancer or other effects through direct action at the point of application. For such locally active compounds, it may be inappropriate to evaluate risks based on oral response data.

As recommended by EPA guidance (EPA 2004), an adjustment to the oral toxicity factor to account for the estimated absorbed dose was applied when the toxicity value derived from the critical study was based on an oral dose and GI absorption of the chemical is less than 50 percent from a medium similar to the one used in the critical study.

Dermal RfDs for assessing dermal exposure were calculated using the following equation:

$$RfD_{dermal} = RfD_o \times ABS_{GI}$$

RfD_{dermal} = dermal reference dose (mg/kg-day)
RfD_o = child exposure duration (years)
ABS_{GI} = fraction of contaminant absorbed in gastrointestinal tract

Cancer slope factors for assessing dermal exposure were calculated as follows:

$$SF_{dermal} = \frac{SF_o}{ABS_{GI}}$$

SF_{dermal} = dermal cancer slope factor $(mg/kg\text{-}day)^{-1}$
SF_o = oral cancer slope factor $(mg/kg\text{-}day)^{-1}$

ABS_{GI} = fraction of contaminant absorbed in gastrointestinal tract

5.0 RISK CHARACTERIZATION

Risk characterization integrates the information from the exposure assessment and toxicity assessment, using a combination of qualitative and quantitative information to provide numerical estimates of potential adverse health effects. Risk characterization is performed separately for carcinogenic and noncarcinogenic effects. Carcinogenic risk is expressed as the probability that an individual will develop cancer over a lifetime as a result of exposure to a potential carcinogen. Noncarcinogenic hazards are evaluated by comparing an estimated exposure level or dose with a reference dose that is without appreciable risk of adverse health effects.

5.1 RISK CHARACTERIZATION METHODOLOGY

This section describes how noncancer hazards and cancer risks were estimated in this BHHRA.

5.1.1 Noncancer Hazard Estimates

The potential for adverse noncancer health effects is generally addressed by comparing the CDI to the corresponding RfD to yield a hazard quotient (HQ; EPA 1989):

$$HQ = \frac{CDI}{RfD}$$

The calculation of a HQ assumes that exposures less than the RfD are unlikely to result in adverse health effects, even for sensitive populations. By definition, when the HQ is less than 1, the estimated exposure is less than the RfD and adverse health effects are unlikely. Unlike cancer risks, the HQ does not represent a statistical probability, and the likelihood of adverse effects does not increase in a linear fashion relative to a HQ of 1. Rather, exposures greater than the RfD may result in adverse health effects, but all RfDs do not have equal precision and are not based on the same severity of effects. HQs for individual chemicals were summed to yield a cumulative hazard index (HI). Although a HI provides an overall indication of the potential for noncancer hazards, dose additivity is most appropriately applied to chemicals that induce the same effect via the same mechanism of action. When the HI is greater than 1 due the sum of several HQs of similar value, it is appropriate to segregate the chemical-specific HQs by effect and mechanism of action. In this BHHRA, when the calculated HI was greater than 1, HQs based on the same target organ system were calculated. The target organs or systems on which the RfDs are based are presented in Table 5-1.

5.1.2 Cancer Risk Estimates

The cancer slope factor converts the estimated daily intakes averaged over a lifetime directly to an incremental cancer risk. Cancer risks are calculated by multiplying the estimated LADI of a carcinogen by the SF (EPA 1989):

$$Risk = LADI \times SF$$

The dose-response relationship is generally assumed to be linear through the low-dose portion of the dose-response curve. That is, the risk of developing cancer is assumed to be directly associated with the amount of exposure. However, this linear relationship is valid only when the estimated risk is less than 0.01 (1×10^{-2}). Where contaminant concentrations result in an estimated risk greater than 1×10^{-2}, the following equation was used (EPA, 1989):

$$Risk = 1\text{-}e^{-LADI \times SF}$$

Because the slope factor typically represents an upper confidence limit, carcinogenic risk estimates generally represent an upper-bound estimate, and EPA is confident that the true risk will not be greater than risk estimates obtained using this model, and they may be less than that predicted. Cancer risk estimates for individual chemicals and different exposure pathways were summed where exposure was assumed to be concurrent to obtain the cumulative excess lifetime cancer risk for each receptor and/or exposure scenario.

5.1.3 Infant Consumption of Human Milk

As discussed in Section 3.3.7, infant exposure to persistent, lipophilic contaminants via breastfeed was quantitatively evaluated in the BHHRA. Using the methodology presented in Section 3.5.5, DEQ determined that the magnitude of the difference in the risk and hazard estimates between the infant and the mother remain constant regardless of the maternal exposure pathway or dose, and can be expressed as infant risk adjustment factors (IRAFs, DEQ 2010):

$$Risk_{infant} = Risk_{mother} \times IRAF_{ca}$$

$$HQ_{infant} = HQ_{mother} \times IRAF_{nc}$$

where:

HQ_{infant} = hazard quotient for breast-fed infant
HI_{mother} = hazard quotient for the mother
$Risk_{infant}$ = cancer risks to breast-fed infant
$Risk_{mother}$ = cancer risks to the mother
$IRAF_{ca}$ = infant risk adjustment factor for carcinogenic effects
$IRAF_{nc}$ = infant risk adjustment factor for noncancer effects

Where combined child and adult exposures were evaluated, the combined child/adult risks were used as the maternal cancer risk for assessing risks to infants. The chemical-specific IRAFs are presented in the following table:

Chemical	$IRAF_{ca}$	$IRAF_{nc}$
PCBs	1	25
Dioxins/Furans	1	2
DDx	0.007	2
PBDEs	1	2

5.1.4 Risk Characterization for Lead

Health effects associated with exposure to inorganic lead and compounds are well documented and include neurotoxicity, developmental delays, hypertension, impaired hearing acuity, impaired hemoglobin synthesis, and male reproductive impairment. Importantly, many of lead's health effects may occur without other overt signs of toxicity. Lead has particularly significant effects in children, and it appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. Because of the difficulty in accounting for pre-existing body burdens of lead and the apparent lack of threshold, EPA determined that it was inappropriate to develop a RfD. The Centers for Disease Control (CDC) has identified a blood lead concentration of 10 micrograms per deciliter (µg/dL) as the level of concern above which significant health effects may occur (CDC 1991), and the concentration of lead in the blood is used as an index of the total dose of lead regardless of the route of exposure (EPA 1994). An acceptable risk is generally defined as a less than 5 percent probability of exceeding a blood lead concentration of 10 µg/dL (EPA 1998).

Using the ALM (EPA 2003c), acceptable lead concentrations in fish tissue that are unlikely to result in fetal blood lead concentrations greater than 10 µg/dL were calculated using the following equation:

$$PbF = \frac{\left(\left[PbB_f / R \times GSD^{1.645}\right] - PbB_o\right) \times AT}{BKSF \times \left(IR_F \times AF_F \times EF_F\right)}$$

Where:

PbB_a	=	Central tendency of adult blood lead level
PbB_o	=	Adult baseline blood lead level
PbB_f	=	Fetal blood lead level
R	=	Fetal/maternal blood lead ratio
GSD	=	Geometric standard deviation PbB
BKSF	=	Biokinetic slope factor

PbF = Lead fish tissue concentration
IR_F = Consumption rate of fish
AF_F = Gastrointestinal absorption of lead from fish
EF_F = Exposure frequency for fish consumption
AT = Averaging time

The values used in this analysis are presented in Attachment F5. Because the lead models calculate a central tendency or geometric mean blood lead concentration, median values are typically used as inputs. The mean estimate of national per capita fish consumption of 7.5 g/day (EPA 2000b) was used as the consumption rate for recreational fishers, the median consumption rate of 39.2 g/day from the CRITFC study was used for tribal fishers. Using the equation presented above, the target lead concentrations in fish are 5.2 mg/kg for recreational fishers and 1 mg/kg for tribal fishers.

EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model was used to calculate tissue lead concentrations unlikely to result in blood lead concentrations greater than 10 µg/dL in children. Because site-specific values for concentration of lead in soil, house dust, air and drinking water were not readily available, default values were used for those inputs. The ratio of child-to-adult consumption of 0.42 was applied to the median adult consumption rate of 7.5 g/day to obtain a childhood rate of 3.2 g/day for children of recreational fishers The corresponding lead concentrations in fish is 2.6 mg/kg. Assuming a consumption rate of 16.2 g/day for tribal children, representing the 65th percentile consumption rate from the CRITFC survey, the calculated lead concentration in fish is 0.5 mg/kg. Uncertainties associated with the evaluation of lead are discussed further in Section 6.

5.1.5 Cumulative Risk Estimates for Contaminants Analyzed by More Than One Method

In some instances specific contaminants were analyzed by more than one method, and thus more than one EPC calculated for that contaminant. Cumulative risks are presented using the EPC from only one method to avoid double-counting the risks from a given contaminant. When assessing risks associated with sediment exposures, Aroclor data was used because the data set was larger than for congeners. However, because the congener analysis provided lower detection limits, it was preferentially used when available for assessing risks associated with consumption of fish and shellfish. Where metals were analyzed as both total and dissolved fractions in surface water and groundwater seep samples, the EPCs based on total metals were used in the cumulative risk estimates because unfiltered data is generally more representative of typical human exposure.

5.2 RISK CHARACTERIZATION RESULTS

This section presents a summary of the risk characterization results the scenarios described in Section 3. EPA policy (EPA 1991a) states that CERCLA actions are generally warranted when where the baseline risk assessment indicates that a cumulative site risk to an individual using RME assumptions for either current or future land use is greater than the 1 x 10^{-4} lifetime excess cancer risk end of the cancer risk range of 1 x 10^{-4} to 1 x x 10^{-6}, or the HI is greater than 1. Accordingly, risk and hazard estimates are generally presented in terms of whether they are greater than the upper end of the cancer risk range of 1 x 10^{-4} or the HI is greater than 1. Uncertainties associated with the assumptions in each exposure scenario are discussed in detail in Section 6. Risks from exposures to PBDEs in in-water sediment and tissue were assessed separately, and are presented in Attachment F3.

5.2.1 Dockside Workers

Risks to dockside workers were estimated separately for each of the eight beaches designated as a potential dockside worker use areas, shown in Map 2-1.

The estimated CT and RME cancer risks are less than 1 x 10^{-4} at all beach areas, and the HI is less than 1 for adults and infants.

5.2.2 In-Water Workers

As discussed in Section 3.2.1.2, in-water workers are described as typically working around in-water structures such as docks, and primarily exposed to in-water sediments. In-water sediment exposure by in-water workers was evaluated in half-mile increments along each side of the river. The estimated CT and RME cancer risks are less than 1 x 10^{-4} at all RM segments, and the RME HIs for adults are less than 1 at any location. The HI for infants is 2 at RM 7W, and dioxin and furans are the primary contributors to the estimate. These results are presented in Tables 5-21, 5-22, 5-34 and 5-35.

5.2.3 Transients

Risks to transients were estimated separately for each beach designated as a potential transient use area, as well as the use of surface water as a source of drinking water and for bathing. Beaches where sediment exposure was evaluated are shown on Map 2-1. Year-round exposure to surface water for four individual transect stations, Willamette Cove, Multnomah Channel, and for the four transects grouped together to represent Study Area-wide exposure are shown on Map 2-3. The CT and RME risk estimates for beach sediment are less than 1 x 10^{-4} for all locations, and the HI is less than 1. The results of the RME and CT evaluations for exposure to beach sediments are presented in Tables 5-4 and 5-5, respectively.

Estimated CT and RME cancer risks associated with surface water exposures are less than 1 x 10^{-4} at all individual and transect locations, and the HI is less than 1. The results of the RME and CT evaluations are presented in Tables 5-46 and 5-47, respectively.

As noted in Section 3.3.4, exposure to surface water by transients was also evaluated at the groundwater seep at Outfall 22B. All risk and hazard estimates are less than 1×10^{-4} and 1, respectively, and the results are presented in Tables 5-64 and 5-65.

5.2.4 Divers

Commercial divers were evaluated for exposure to surface water and in-water sediment, and assuming the diver was wearing either a wet or a dry suit. As described in Section 3.4.2, in-water sediment exposure by divers is evaluated in half-mile exposure areas for each side of the river, and on a Study Area wide basis. Risks associated with exposure to surface water were evaluated for four individual transect stations, and at single-point sampling stations grouped together in one-half mile increments per side of river.

5.2.4.1 Diver in Wet Suit

The estimated CT and RME cancer risk associated with exposure to in-water sediments is less than 1×10^{-4} at all half-mile river segments and for Study Area-wide exposure, and the HI is also less than 1 for adults. The HI for infants is 2 at RM 8.5W for the RME evaluation, and PCBs are the primary contributor to the hazard estimate. The RME and CT estimates for adults are presented in Tables 5-31 and 5-32, respectively. RME and CT risk and hazard estimates for infant exposures are presented in Tables 5-42 and 5-43, respectively.

The estimated CT and RME cancer risk associated with exposure to surface water is less than 1×10^{-4} for all half-mile river segments, and the HI is less than 1. These results are presented in Tables 5-54 and 5-55, respectively, for the RME and CT evaluations. Indirect exposure to contaminants in surface water by infants via breastfeeding was not evaluated.

5.2.4.2 Diver in Dry Suit

The estimated RME cancer risk is less than 1×10^{-4} at all half-mile river segments and for Study Area-wide exposure, and the HI is also less than 1 for adults and infants. The results of the adult RME risk and hazard estimates are presented in Table 5-33, a CT evaluation was not done for a commercial diver in a dry suit.

The estimated RME cancer risk associated with exposure to surface water is less than 1×10^{-4} for all half-mile river segments, and the HI is less than 1. These results are presented in Tables 5-56. Indirect exposure to contaminants in surface water by infants via breastfeeding was not evaluated.

5.2.5 Recreational Beach Users

Risks associated with exposure to beach sediment were evaluated separately for each beach designated as a potential recreational use area, shown on Map 2-1. Exposure to surface water was evaluated using data collected from three transect locations and three single-point locations (Cathedral Park, Willamette Cove, and Swan Island Lagoon) shown on Map 2-3.

The estimated CT and RME cancer risks associated with exposure to beach sediments are less than 1 x 10^{-4} at all recreational beach areas, and the HI is also less than 1. These results are presented in Tables 5-6 through 5-11. Indirect exposure to contaminants in beach sediment to infants via breastfeeding was not evaluated.

The results of the risk evaluation for exposure to surface water by recreational beach user are presented in Tables 5-48 through 5-53. The estimated CT and RME cancer risks associated with exposure to surface water are less than 1 x 10^{-4} at all recreational beach areas, and the HI is also less than 1. These results are presented in Tables 5-50 through 5-53.

5.2.6 Recreational/Subsistence Fishers

Recreational and subsistence fishers were evaluated assuming direct exposure to contaminants in sediment and via consumption of fish and shellfish. As discussed in Section 3.2.1.6, exposures associated with beach sediment were assessed at individual beaches designated as potential transient or recreational use areas, in-water sediment exposures were evaluated on a one-half river mile basis per side of the river and as an averaged, Study Area-wide evaluation. Sediment exposures were further assessed as CT and RME evaluations and assuming either a low- or a high-frequency rate of fishing.

5.2.6.1 Sediment-Direct Contact

The estimated CT and RME cancer risks associated with low-frequency fishing exposures to either beach or in-water sediments are less than 1 x 10^{-4} at all areas evaluated. Noncancer hazards associated with adult exposures are less than 1 at all locations evaluated, the noncancer hazard associated with indirect exposures to infants via breastfeeding is greater than 1 at two locations: RM 7W (2), where dioxin/furan TEQ concentrations are the primary contributor, and RM 8.5W (2), where PCBs are the primary contributor, with a HQ of 1. These results are presented in Tables 5-16 and 5-17 for beach sediment exposures, and Tables 5-29 and 5-30 for in-water sediment exposures.

The estimated CT and RME cancer risks associated with high-frequency fishing exposures to either beach or in-water sediments are less than 1 x 10^{-4} at all areas evaluated. Noncancer hazards associated with adult exposures are greater than 1 at RM 7W (2), with dioxin/furan TEQ concentrations as the primary contributor the noncancer hazard. The noncancer hazard associated with indirect exposures to infants via breastfeeding is also greater than 1 at RM 7W (3), where dioxin/furan TEQ concentrations are the primary contributor, and RM 8.5W (2), where PCBs are the primary contributor with a HQ of 2. These results are presented in Tables 5-14 and 5-15 for beach sediment exposures, and Tables 5-26 through 5-28 for in-water sediment exposures.

5.2.6.2 Consumption of Smallmouth Bass

Consumption of both whole body and fillet-only smallmouth bass was evaluated on a river mile basis to account for their relatively small home range. An additional analysis averaging consumption over the entire Study Area was also conducted. The estimated CT and RME cancer risks associated with combined child and adult consumption of whole body smallmouth bass are greater than 1 x 10^{-4} for all river miles evaluated, and RME cancer risk estimates are greater than 1 x 10^{-3} for each river mile. CT cancer risk estimates are greater than 1 x 10^{-3} at RM 7, RM 11, and at Swan Island Lagoon. Study Area-wide RME risks for recreational and subsistence fishers are 7 x 10^{-3} and 4 x 10^{-3}, the CT estimate for recreational fishers is 9 x 10^{-4}. Values for river miles having the highest estimated RME risks are as follows (for recreational and subsistence fishers, respectively): RM 7 (6 x 10^{-3} and 1 x 10^{-2}), Swan Island Lagoon (6 x 10^{-3} and 1 x 10^{-2}), and RM 11 (1 x 10^{-2} and 2 x 10^{-2}). Dioxins/furans, PCBs and DDx are the primary contributors to the overall risk at RM 7; PCBs, and to a lesser degree dioxins/furans, are the primary contributors in Swan Island Lagoon and at RM 11.

RME risk estimates for fillet-only consumption are all greater than 1 x 10^{-4}, the CT estimate is greater than 1 x 10^{-4} at RM 7 and RM 11. Study Area-wide RME risks for recreational and subsistence fishers are 9 x 10^{-4} and 2 x 10^{-3}, the CT estimate for recreational fishers is 2 x 10^{-4}. River miles having the highest estimated risks are (for recreational and subsistence fishers, respectively): RM 7 (9 x 10^{-4} and 2 x 10^{-3}) and RM 11 (2 x 10^{-3} and 3 x 10^{-3}), fillet-only data were not collected in Swan Island Lagoon. Dioxins/furans and PCBs are the primary contributors to the overall risk as RM 7, PCBs, and to a lesser degree dioxins/furans, are the primary contributors in Swan Island Lagoon and at RM 11. These results are presented in Table 5-114.

RME noncancer hazards associated with childhood consumption of whole body smallmouth bass are greater than 1 at all river miles evaluated. Areas with the highest estimated hazard displays a pattern similar to those with highest cancer risks. Values for river miles having the highest estimated hazard are as follows (for recreational and subsistence fishers, respectively): RM 7 (300 and 600), Swan Island Lagoon (500 and 1,000), and RM 11 (700 and 1,000). The highest values for the CT noncancer hazard estimates for recreational fishers are 70 (RM 7), 200 (RM 11), and 100 (Swan Island Lagoon). Study Area-wide RME hazards for recreational and subsistence fishers are 200 and 500, respectively, the CT estimate for recreational fishers is 60.

Dioxins/furans and PCBs are the primary contributors at RM 7, while PCBs are predominantly the contributor in Swan Island Lagoon and at RM 11.

RME hazard estimates for fillet-only consumption are also greater than 1 at all river miles. Values for river miles having the highest estimated RME hazard for fillet-only consumption are as follows (for recreational and subsistence fishers, respectively): RM 7 (50 and 90), and RM 11 (100 and 300); fillet-only data were not collected in Swan Island Lagoon. Study Area-wide RME hazards for recreational and subsistence fishers are 70 and 100, respectively, the CT estimate for recreational fishers is 20. PCBs and dioxin/furans are the primary contributors to the hazard estimates at RM 7 while PCBs are the primary contributor to the hazard estimate at RM 11. These results are presented in Table 5-94.

RME and CT noncancer hazard associated with indirect exposure to infants via breastfeeding was also assessed. Values for river miles having the highest estimated RME hazard due to consumption of whole body smallmouth bass are as follows (for infant children of recreational and subsistence fishers, respectively): RM 7 (3,000 and 5,000), Swan Island Lagoon (6,000 and 10,000), and RM 11 (8,000 and 20,000). The associated CT estimates for recreation fishers are 600 at RM 7, 1,000 at Swan Island Lagoon, and 2,000 at RM 11. The RME hazard estimates associated with fillet-only consumption are: RM 7 (300 and 600), and RM 11 (2,000 and 4,000), fillet-only data were not collected in Swan Island Lagoon. The comparable CT estimates for recreational fishers are 70 at RM 7, and 500 at RM 11. PCBs are the primary contributors to the estimated noncancer hazard estimates. These results are presented in Table 5-119.

5.2.6.3 Consumption of Common Carp

Consumption of Common carp was evaluated assuming fish were caught from one of five overlapping fishing zones described in Section 3.4.5, as well as on a Harbor-wide basis. The estimated RME cancer risks associated with combined child and adult consumption of whole body common carp are greater than 1×10^{-4} in each fishing zone evaluated. Values for fishing zones having the highest estimated risks are as follows (RME estimates for recreational and subsistence fishers, respectively): FZ 3-6 (1×10^{-2} and 2×10^{-2}), FZ 4-8 (3×10^{-2} and 7×10^{-2}, and FZ 8-12 (2×10^{-3} and 5×10^{-3}). The Study Area-wide risk estimates are 4×10^{-2} and 2×10^{-2}. CT estimates for recreational fishers are greater than 1×10^{-4} in all fishing zones, and is 5×10^{-3} when evaluated Study Area-wide. PCBs, dioxins/furans, and DDx are the primary contributors to the estimated risks assuming whole body consumption, dioxins/furans were not analyzed in fillet samples collected from FZs 3-6 and 6-9.

The RME risk estimates for fillet-only consumption (for recreational and subsistence fishers, respectively) are: FZ 3-6 (1×10^{-3} and 2×10^{-3}), FZ 4-8 (2×10^{-2} and 4×10^{-2}, and FZ 8-12 (1×10^{-3} and 2×10^{-3}). The Study Area-wide RME risk estimates are 4×10^{-2} and 2×10^{-2}. The CT estimate for recreational fishers is 1×10^{-4} in FZ 0-4, all other CT estimates are greater than 1 x 10^{-4}. These results are presented in Table 5-115.

RME noncancer hazards associated with childhood consumption of whole body common carp are greater than 1 in each fishing zone evaluated. Values for fishing zones having the highest estimated hazard are as follows (RME estimates for recreational and subsistence fishers, respectively): FZ 3-6 (900 and 2,000) and FZ 4-8 (3,000 and 5,000). The Study Area-wide estimates are 2,000 and 4,000. The associated CT estimates for recreational fishers is 200 at FZ 3-6, 600 in FZ 4-8, and 500 Study Area-wide. The comparable hazard estimates for fillet-only consumption are: FZ 3-6 (200 and 100), FZ 4-8 (4,000 and 2,000), and 500 Study Area-wide. CT estimates for recreational fishers are 30 in FZ 3-6, 500 in FZ 4-8, and 500 Study Area-wide. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-98

RME noncancer hazards associated with indirect exposure to infants via breastfeeding are greater than 100 in each fishing zone evaluated. Values for fishing zones having the highest estimated hazard are as follows (infant children of recreational and subsistence fishers, respectively): FZ 3-6 (10,000 and 20,000) and FZ 4-8 (30,000 and 60,000); Study Area-wide estimates are 30,000 and 50,000, respectively. The comparable CT estimates for infants of recreational fishers are 3,000 in FZ 3-6, 8,000 in FZ 4-8, and 6,000 Study Area-wide.

RME hazard estimates associated with fillet-only consumption are (for infants of recreational and subsistence fishers, respectively): FZ 3-6 (1,000 and 3,000), FZ 4-8 (30,000 and 50,000); the Study Area-wide estimates are 30,000 and 50,000. CT estimates for infants of recreational fishers are 400 in FZ 3-6, 6,000 at FZ 4-8, and 6,000 Study Area-wide. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-120.

5.2.6.4 Consumption of Brown Bullhead

Data from brown bullhead was combined across two fishing zones, encompassing RMs 3-6 and 6-9, was well as combining these data to provide a Study Area wide assessment. The RME estimates assuming whole body consumption are (for recreational and subsistence fishers, respectively) are 6 x 10^{-4} and 1 x 10^{-3} in FZ 3-6, 6 x 10^{-4} and 4 x 10^{-3} in FZ 6-9, and 2 x 10^{-3} and 4 x 10^{-3} Study Area-wide. The associated CT estimates for recreational fishers are 2 x 10^{-4} in FZ 3-6, 6 x 10^{-4} in FZ 6-9, and 5 x 10^{-4} Study Area wide.

RME risk estimates for recreational and subsistence fishers, respectively, assuming fillet-only consumption are 7 x 10^{-5} and 1 x 10^{-4} in FZ 3-6, and 1 x 10^{-3} and 2 x 10^{-3} in FZ 6-9. The Study Area-wide risk estimates are 1 x 10^{-3} and 2 x 10^{-3}. The associated CT estimates for recreational fishers are 2 x 10^{-5} in FZ 3-6, 3 x 10^{-4} in FZ 6-9, and 3 x 10^{-4} Study Area wide. These results are presented in Table 5-116.

RME noncancer hazards associated with childhood consumption of whole body brown bullhead are greater than 1 in all instances. The RME estimates for recreational and subsistence fishers, respectively, are 40 and 70 in FZ 3-6, 200 and 400 in FZ 6-9, and 200 and 300 Study Area-wide. CT estimates for recreational fishers are 8 in FZ 3-6, 50 in FZ 6-9, and 40 Study Area-wide.

RME hazard estimates assuming fillet-only consumption are 7 and 10 in FZ 3-6, 100 and 300 in FZ 6-9, and 100 and 300 Study Area-wide. CT estimates for recreational fishers assuming fillet-only consumption are 2 at FZ 3-6, 30 at FZ 6-9, and 30 Study Area-wide. These results are presented in Table 5-102.

Assuming whole body consumption of brown bullhead, the RME noncancer hazards associated with indirect exposure to infant children of recreational and subsistence fishers, respectively, via breastfeeding are 300 and 600 in FZ 3-6, 2,000 and 5,000 in FZ 6-9, and 2,000 and 4,000 Study Area-wide. CT estimates for infants of recreational fishers are 70 at FZ 3-6, 600 at FZ 6-9, and 500 Study Area-wide. The RME hazard estimates assuming parental fillet-only consumption are 70 and 100 in FZ 3-6, 2,000 and 3,000 in FZ 6-9, and 2,000 and 3,000 Study Area-wide. CT estimates for infants of recreational fishers are 20 at FZ 3-6, 400 at FZ 6-9, and 400 Study Area-wide. These results are presented in Table 5-121.

5.2.6.5 Consumption of Black Crappie

Data from black crappie was also combined across two fishing zones, encompassing RMs 3-6 and 6-9, was well as combining these data to provide a Study Area wide assessment. RME estimates assuming whole body consumption for recreational and subsistence fishers, respectively, are 3 x 10^{-4} and 6 x 10^{-4} in FZ 3-6, 6 x 10^{-4} and 1 x 10^{-3} in FZ 6-9, and 6 x 10^{4} and 1 x 10^{-3} Study Area-wide. The comparable CT estimates for recreational fishers are 9 x 10^{-5} in FZ 3-6, 2 x 10^{-4} in FZ 6-9, and 2 x 10^{4} Study Area-wide.

RME risk estimates assuming fillet-only consumption are 3 x 10^{-5} and 6 x 10^{-5} at FZ 3-6, 4 x 10^{-5} and 8 x 10^{-5} in FZ 6-9, and 4 x 10^{-5} and 8 x 10^{-5}. CT estimates for recreational fishers are 9 x 10^{-6} in FZ 3-6, 1 x 10^{-5} in FZ 6-9, and 1 x 10^{-5} Study Area-wide These results are presented in Table 5-117.

RME noncancer hazards associated with childhood consumption of whole body black crappie are greater than 1 in all instances. The RME estimates for recreational and subsistence fishers, respectively, are 20 and 40 in FZ 3-6, 40 and 80 in FZ 6-9, and 40 and 80 Study Area-wide. CT estimates for recreational fishers are 8 in FZ 3-6, 50 in FZ 6-9, and 40 Study Area-wide.

RME hazard estimates assuming childhood fillet-only consumption for recreational and subsistence fishers, respectively, are 4 and 8 at FZ 3-6, and 6 and 10 at FZ-6-9. The associated Study Area-wide risk estimates assuming fillet-only consumption are 6 and 10. CT estimates for recreational fishers assuming fillet-only consumption are 2 in FZ 3-6, 30 in FZ 6-9, and 30 Study Area-wide. These results are presented in Table 5-102.

Assuming adult whole body consumption of black crappie, the RME noncancer hazards associated with indirect exposure infants to infant children of recreational and subsistence fishers, respectively, via breastfeeding are 100 and 300 at FZ 3-6, 400 and 700 at FZ 6-9, and 400 and 700 Study Area-wide. CT estimates for infants of recreational fishers assuming fillet-only consumption are 70 in FZ 3-6, 600 in FZ 6-9, and 500 Study Area-wide.

RME hazard estimates for infants of recreational and subsistence fishers, respectively, assuming parental fillet-only consumption are 30 and 60 at FZ 3-6, and 40 and 80 at FZ 6-9. The associated Study Area-wide risk estimates assuming fillet-only consumption are 40 and 80. These results are presented in Table 5-121.

5.2.6.6 Multi-Species Diet

A multi-species diet, comprised of equal proportions of each of smallmouth bass, common carp, brown bullhead, and black crappie was evaluated on a harbor-wide basis. The estimated recreational fisher CT and RME cancer risk estimates for combined child and adult consumption of whole body fish are 2×10^{-3} and 7×10^{-3}, respectively, and the estimated risk for subsistence fishers is 1×10^{-2}. The corresponding CT and RME risk estimates for recreational fishers based on fillet-only consumption are 1×10^{-3} and 6×10^{-3}, respectively. The estimated risk for subsistence fishers is 1×10^{-2}. PCBs, dioxins/furans, and DDx are the primary contributor to the risk estimates. These results are presented in Table 5-118.

The RME noncancer hazard estimates for childhood consumption of whole body fish for recreational and subsistence fishers are 600 and 1,000, respectively. The associated RME estimates for fillet-only consumption are 500 and 1,00, respectively. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-110.

The RME noncancer hazard estimates for indirect exposure by infants via breastfeeding assuming maternal consumption of whole body fish are 8,000 for recreational fishing and 10,000 for subsistence fishing. The associated RME estimates associated with maternal fillet-only consumption are 7,000 for recreational fishing and 1,000 for subsistence. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-123

5.2.6.7 Consumption of Clams

The estimated RME cancer risks associated consumption of undepurated clams by subsistence fishers are greater than 1×10^{-4} at 10 of the 22 river mile sections evaluated. Values for river miles having the highest estimated risks are as follows: RM 5W (6×10^{-4}), RM 6E (7×10^{-4}), and RM 6W (7×10^{-4}). Other areas where the estimated risk is equal to or greater than 1 x 10^{-4} are RM 2E, 3E, 4E, 4W, 7W, 8W, Swan Island Lagoon, 9W, and 11E. The estimated risk Study Area-wide is 4 x 10^{-4}. Carcinogenic PAHs and PCBs are generally the primary contributors to the overall risk, cPAHs are the primary contributors to the risk estimates at RMs 5W and 6W. at RM 7, PCBs and dioxins/furans are the primary contributors in Swan Island Lagoon and at RM 11. No estimated CT cancer risks associated with consumption of undepurated clams are greater than 1 x 10^{-4}. Risks were also evaluated based on consumption of depurated clams at RM 1E, RM 2W, RM 10, RM 11E, and RM 12E. None of the estimated CT or RME cancer risks are greater than 1 x 10^{-4}. These results are presented in Table 5-126.

The estimated RME noncancer hazards associated consumption of undepurated clams by subsistence fishers are greater than 1 at 20 of the 22 river mile sections evaluated. Values for river miles having the highest noncancer hazard are as follows: RM 3E (8), RM 6E (40), RM 9W (8), and RM 11E (10). The estimated noncancer hazard Study Area-wide is 9. PCBs and dioxins/furans are the primary contributors in Swan Island Lagoon, RM 5W, 6W RM 7 and at RM 11. The estimated CT hazards associated with consumption of undepurated clams is greater than 1 at RM 6E, where the HI is 7, and PCBs are the primary contributor to the hazard estimate. The estimated hazard associated with consumption of depurated clams is greater than 1 for the RME estimate at RM 11E, where the HI is 7. PCBs are the primary contributor to the estimated hazard. These results are presented in Table 5-126.

RME noncancer hazard associated with indirect exposure to infants via breastfeeding was also assessed, and the estimated hazard is greater than 1 at each river mile evaluated. Values for river miles having the highest estimated hazard due to parental consumption of clams are as follows (for infant children of subsistence fishers): RM 2E (20), RM 6E (200), and RM 11E (50). These results are presented in Table 5-132.

5.2.6.8 Consumption of Crayfish

The estimated RME cancer risks associated consumption of crayfish by subsistence fishers are greater than 1 x 10^{-4} at two of the 32 individual stations evaluated: 07R006 (3 x 10^{-4}) located at RM 7W, and CR11E (3 x 10^{-4}) located at RM 11E. When evaluated Study Area-wide, the estimated risk is 3 x 10^{-4}. Dioxins/furans are the primary contributors to the estimated risk at 07R006, PCBs are the primary contributors at CR11E. These results are presented in Table 5-129.

The estimated RME noncancer hazards associated consumption of crayfish by subsistence fishers are greater than 1 at six of the 32 individual stations. Stations having the highest estimated hazard are 03R005 (4) located at the end of the International Slip, 07R006 (6), and CR11E (20). The estimated noncancer hazard Study Area-wide is 10. PCBs are generally the primary contributors to the noncancer hazard at 03R005 and CR11E, dioxins/furans are the primary contributors at 07R006. These results are presented in Table 5-129.

RME noncancer hazard associated with indirect exposure to infants via breastfeeding is greater than 1 at 17 of the 32 stations evaluated. Values at locations having the highest estimated hazard due to parental consumption of clams are as follows (for infant children of subsistence fishers): 02R001 (20) at RM 2E, 03R003 (20) at RM 3E, 03R005 (60) at RM 3E, 07R006 (20) at RM 7W. 09R002 (30) at RM 9W, and CR11E (400) at RM 11E. The hazard is 200 when evaluated Study Area-wide. These results are presented in Table 5-133.

5.2.7 Tribal Fishers

Tribal fishers were evaluated assuming direct exposure to contaminants in sediment and via consumption of fish. Exposures associated with beach sediment were assessed at individual beaches, in-water sediment exposures were evaluated on a one-half river mile basis per side of the river and as an averaged, Study Area-wide evaluation. Fish consumption was evaluated assuming a multi-species diet consisting of anadromous and resident fish species, and fishing was evaluated on a Study Area-wide basis.

5.2.7.1 Sediment – Direct Contact

The estimated CT and RME cancer risks associated with direct contact to beach sediment is less than 1 x 10^{-4} at all beaches evaluated. The estimated RME cancer risk associated with exposure to in-water sediment is greater than 1 x 10^{-4} at two locations: RM 6W (2 x 10^{-4}) and RM 7W (3 x 10^{-4}). PAHs are the primary contributors to the risk estimate at RM 6W, dioxins/furans are the primary contributors at RM 7W. These results are presented in Table 5-12 and 5-13.

With the exception of in-water sediment exposure at RM 7W, the estimated non-cancer hazard is less than one at all beach and in-water locations evaluated. The estimated hazard is 3 at RM 7W, and dioxins/furans are the primary contributors to the estimate. These results are presented in Tables 5-12 and 5-13.

Noncancer RME hazard estimates associated with indirect exposure to infants via breastfeeding was evaluated assuming maternal exposure to in-water sediment. The estimated hazard is greater than 1 at 3 locations, RM 7W (5), RM 8.5_(4), and RM 11E (2). These results are presented in Table 5-40.

5.2.7.2 Fish Consumption

The estimated RME cancer risks for the combined child and adult exposure is 2 x 10^{-2} assuming whole body consumption, and 1 x 10^{-2} assuming consumption of fillets only. PCBs, and to a lesser extent dioxins/furans are the primary contributors to the overall risk estimates. These results are presented in Table 5-71.

The RME noncancer hazard associated with childhood consumption of whole body fish is 800, and is 600 assuming consumption of fillets only. PCBs, and to a lesser extent dioxins/furans, arsenic, and DDx are the primary contributors to the overall risk estimates. These results are presented in Table 5-69.

The RME noncancer hazard associated with indirect exposure of tribal infants via breastfeeding assuming maternal consumption of whole body fish is 9,000, and is 8,000 assuming maternal fillet-only consumption. PCBs are the primary contributors to the hazard estimates. These results are presented Table 5-72.

5.2.8 Domestic Water Use

Use of surface water as a source of household water for drinking and other domestic uses was evaluated using data from five transect and 15 single point sampling locations, as well as averaged over a Study Area-wide basis. The estimated cancer risk for combined child and adult exposures is greater than 1×10^{-4} at W031 (3×10^{-4}), located at RM 6W. PAHs are the primary contributor to the estimated cancer risk. However, dermal exposure is the primary pathway contributing to the risk estimate, and as described in EPA 2004, the physical-chemical properties of several PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene), place them outside of the Effective Prediction Domain used to estimate the absorbed dermal dose from water. Although PAHs are direct-acting carcinogens, the risk estimates associated with estimating dermal absorption from water have a greater degree of uncertainty than the other risk estimates presented in this BHHRA. These results are presented in Table 5-62.

The estimated noncancer hazard based on childhood exposure is equal to or greater than 1 at several sampling locations: W005 (1) at RM 4E, W023 (1) at RM 11, W027 (2) near the mouth of Multnomah Channel, and W035 (2) in Swan Island Lagoon. In all instances, MCPP is the primary contributor to the estimated hazard. These results are presented in Table 5-59.

5.3 CUMULATIVE RISK ESTIMATES

Cumulative risk and hazard estimates were calculated for those populations where concurrent exposure to more than one media was assumed to be plausible. Recreational/subsistence and tribal fishers were further evaluated on the basis of whether they were assumed to fish predominately from the shore or from a boat. Populations for which concurrent exposure to more than one media was considered for are as follows:

- Transients: Beach sediment, in-water sediment, surface water
- Divers: In-water sediment, surface water
- Recreational beach users: Beach sediment, surface water

- Recreational fishers (beach): Beach sediment, fish tissue (fillet or whole body)
- Recreational fishers (boat): In-water sediment, fish tissue (fillet or whole body)
- Subsistence fishers (beach): Beach sediment, fish tissue (fillet or whole body), shellfish tissue
- Subsistence fishers (boat): In-water sediment, fish tissue (fillet or whole body), shellfish tissue
- Tribal fishers (beach): Beach sediment, fish tissue (fillet and whole body)
- Tribal fishers (boat): In-water sediment, fish tissue (fillet and whole body)

Cumulative risk estimates are generally presented for each one-half river mile per side of the river, and the risk estimates for specific media appropriate to each one-half mile segment were used to calculate the total risk or hazard. For example, cumulative risks for subsistence fishers who fish from a boat and consume smallmouth bass would include the risks associated with exposure to in-water sediment at the specific half-mile, shellfish collected within same half-mile and side-of-river specific segment, and smallmouth bass from the larger river mile assessment. The results of the cumulative risk estimates are presented in Table 5-xxx through 5-xxx. Chemicals that resulted in a cancer risk greater than 1 x 10^{-6} or an HQ greater than 1 under any of the exposure scenarios for any of the exposure point concentrations evaluated in this BHHRA are presented in Table 5-xxx.

5.4 SUMMARY OF RISK CHARACTERIZATION

Cancer risk and noncancer hazard from site-related contamination was characterized based on current and potential future uses at Portland Harbor, and a large number of different exposures scenarios were evaluated. Exposure to bioaccumulative contaminants (PCBs, dioxins/furans, and organochlorine pesticides, primarily DDx compounds, via consumption of resident fish consistently poses the greatest potential for human exposure to in-water contamination. In general, the risks associated with consumption of resident fish are greater by an order of magnitude or more than risks associated with exposure to sediment or surface water. The greatest non-cancer hazard estimates are associated with bioaccumulation through the food chain and exposure to infants via breastfeeding. Because the smallest scale over which fish consumption was evaluated was per river mile, the resolution of cumulative risks on a smaller scale is not informative. The highest relative cumulative risk or hazard estimates are at RM 2, RM 4, RM 7, Swan Island Lagoon, and RM 11. However, assuming exposure to sediment alone, areas posing the greatest risk are RM 6W, RM 7W, RM 8.5W, and RM 11E, shellfish consumption alone poses the greatest risks at RM 4E, RM 5W, RM 6W, and RM 6E.

The results of the BHHRA will be used to derive risk-based PRGs and AOPCs for the FS, as well as to develop risk management recommendations for the Site. In addition, the BHHRA may be consulted by risk managers as they deliberate practical risk management objectives during the course of the FS.

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6.0 UNCERTAINTY ANALYSIS

The presence of uncertainty is inherent in the risk assessment process, from the sampling and analysis of chemicals in environmental media to the assessment of exposure and toxicity, and risk characterization. EPA policy calls for numerical risk estimates to always be accompanied by descriptive information regarding the uncertainties of each step in the risk assessment to ensure an objective and balanced characterization of the true risks and hazards.

The term "uncertainty" is often used in risk assessment to describe what are, in reality, two conceptually different terms: uncertainty and variability. Uncertainty can be described as the lack of a precise knowledge resulting in a fundamental data gap. Variability describes the natural heterogeneity of a population. Uncertainty can sometimes be reduced or eliminated through further measurements or study. By contrast, variability is inherent in what is being observed. Although variability can be better understood, it cannot be reduced through further measurement or study, although it may be more precisely defined. However, the additional cost of further data collection may become disproportional to the reduction in uncertainty.

The risks and hazards presented are consistent with EPA's stated goal of RME representing the high end of the possible risk distribution, which is generally considered to be greater than the 90th percentile. However, these estimates are based on numerous and often conservative assumptions and, in the absence of definitive information, assumptions are used to ensure that actual sites risks are not underestimated. The cumulative effect of these assumptions can result in an analysis having an overall conservativeness greater than the individual components. Accordingly, it is important to note that the risks presented here are based on numerous conservative assumptions in order to be protective of human health and to ensure that the risks presented here are more likely to be overestimated rather than underestimated

6.1 DATA EVALUATION

As discussed in Section 2, sediment, surface water, groundwater seep, and biota data were collected during the RI. Data of confirmed quality that meet the DQOs for risk assessment were used in this BHHRA to estimate exposures. Although uncertainty is inherent in environmental sampling, the use of the EPA's DQO planning process (EPA 2000e) minimized the uncertainty associated with the data collected during the RI. A discussion of key data evaluation uncertainties is presented in the following sections.

6.1.1 Use of Target Species to Represent All Types of Biota Consumed

Because it is not practical to collect samples of every resident fish and shellfish species consumed by humans within the Study Area, as recommended by EPA guidance (2000a), target resident species were selected to represent the diet of all types likely consumed by humans. Four target species were collected to represent a diet consisting of resident fish: smallmouth bass, black crappie, common carp, and brown bullhead. Crayfish and clam tissue samples were collected to represent a diet containing locally-harvested shellfish. Factors considered in selecting the target species included likely consumption by humans, home range, the potential for bioaccumulation of COPCs, the trophic level of species, and their abundance.

PCBs generally represent the greatest contributors to the estimated risks, and detected concentrations are highest in smallmouth bass and common carp. Therefore, the use of target resident species as representative of all biota consumed is unlikely to underestimate potential risks. If non-resident species are consumed, the risks may be less, commensurate with the amount of non-resident species present in the diet.

6.1.2 Source of Chemicals for Anadromous and Wide-Ranging Fish Species

Salmon, lamprey, and sturgeon have traditionally represented a substantial portion of the fish diet of tribal members. These species likely spend a substantial portion of their lives outside of the Study Area, and thus contaminant concentrations in these species may bear little relationship to sediment concentrations in the Study Area.

The Washington Department of Ecology analyzed returning fall Chinook salmon, as fillet tissue with skin, collected from three coastal rivers (the Queets, Quinault, and Chehalis Rivers) in 2004 (Ecology 2007). PCBs as Aroclors were detected at concentrations ranging from 5.0 μg/kg to 6.3 μg/kg in the Ecology study, relative to the maximum detected concentration of 20 μg/kg for salmon fillet tissue with skin collected from the Lower Willamette. The dioxin TEQ concentrations ranged from 0.09 picograms per gram (pg/g) to 0.23 pg/g in the Washington coastal rivers relative to the maximum detected concentration of 2 pg/g for salmon fillet tissue with skin collected from the Lower Willamette. A comparison of the tissue concentrations from the Ecology study and the Lower Willamette indicates that the concentration of PCBs measured as Aroclors and congeners are noticeably greater in salmon collected from the Clackamas fish hatchery relative to concentrations detected in the Ecology study. The reported concentrations of total DDT and dioxins as TEQs are generally consistent between the Ecology study and results from Portland Harbor. These results are summarized in Table 6-2. While the Chehalis River passes through some developed areas and therefore may have localized sources, both the Queets and Quinault Rivers are located almost entirely within Olympic National Forest and wilderness areas, so the potential for contribution from localized sources should be minimal. The degree to which contaminant concentrations in anadromous fish are due to exposures that occur within the Study Area is unknown. However, approximately 95 percent of the cumulative tribal fish consumption risk is due to contaminants detected in resident species, even though they only account for 50 percent of the estimated diet. As a result, the uncertainty associated with the source of chemicals to non-resident fish species should not affect the conclusions of this BHHRA.

6.1.3 Use of Either Whole Body or Fillet Samples to Represent Fish Consumption

Different contaminants are preferentially accumulated in different parts of an organism. Organic compounds tend to accumulate to a greater degree in tissues with a higher fat content, while heavy metals accumulate more in muscle tissues. Thus, diets consisting of different parts of the fish would result in varying levels of exposure to the consumer. The COPCs with the greatest contribution to the cumulative risk and hazard are persistent chlorinated organic compounds (PCBs, DDx, and various PCDD/PCDF congeners) that preferentially accumulate in fatty tissue. As discussed in Attachment F6, the difference in measured concentrations between fillet and whole body can be as great as a factor of 10 or more.

Based on information presented in the Columbia Slough consumption survey (Adolfson 1996), the majority of fishers surveyed consume only the fillet, which may not include skin. According to the CRITFC Survey (CRITFC 1994), tribal fish consumers are also most likely to consume the fillet. However, some individuals or groups consume other portions of the fish. Assuming a diet of whole body or fillet tissue with skin represents a conservative assumption and provides a range of risks associated with different dietary habits. Because it is unlikely that a diet consists entirely of whole body tissue, the evaluation of risks associated with consumption of only whole body tissue provides a health protective approach.

6.1.4 Use of Undepurated Tissue to Represent Clam Consumption

Only a limited number clam tissue samples (five of 22) collected in the Study Area were not depurated prior to analysis. Depuration is a common practice in the preparation of clams for human consumption, although they may also be consumed undepurated. With the exception of certain metals, average chemical concentrations detected in clam tissue in the Study Area were higher in undepurated than in depurated samples. However, depurated clam tissue samples were collected from edges of the site at the northern and southern stretches, and the concentrations are shown in Tables 3-24 and 3-25. Using the concentrations from undepurated samples provides a health-protective approach to assessing risk from consumption of clams.

6.1.5 Use of Different Tissue Sample Preparation to Assess the Same Chemical

Samples of resident fish tissue from Round 1 were analyzed for mercury in fillet tissue without skin, while during Round 3, smallmouth bass and common carp samples were analyzed in fillet tissue with skin. The Round 1 and Round 3 datasets were combined for Study Area analysis. For the reasons presented in Section 6.1.3, the comparability of analytical data from fillet tissue with skin and fillet tissue without skin creates uncertainty in the BHHRA. Because mercury preferentially accumulates in muscle tissue, concentrations would be expected to be higher in the fillet tissue samples without skin. However, for smallmouth bass, mercury concentrations were generally higher in fillet tissue with skin, while in common carp mercury concentrations were generally higher in fillet tissue without skin. A comparison of mercury tissue concentrations is provided in Table 6-3. The uncertainty associated with the use of different tissue types to assess risks from mercury should not affect the conclusions of this BHHRA.

6.1.6 Exclusion of Non-Detected Chemicals Where Detection Limits Exceeded Analytical Concentration Goals

Although site-specific Analytical Concentration Goals (ACGs) were established for each media, ACGs for some chemicals were not attainable in some instances with present laboratory methods. DLs for chemicals that were analyzed but never detected were compared to the appropriate ACG for each media, and the results of that analysis are presented in Tables 6-5 through 6-7.

Chemicals that were not detected were not quantitatively evaluated in the BHHRA. If chemicals were present at concentrations above the ACGs but below the DLs, those chemicals would contribute to the estimated risk and hazard. However, given the number of chemicals that were detected at concentrations above their respective ACGs and the magnitude of difference between detected concentrations and ACGs, it is unlikely that exclusion of chemicals that were not detected would affect the conclusions of this BHHRA.

6.1.7 Removal of Non-Detected Results Greater Than the Maximum Detected Concentration for a Given Exposure Area

As discussed in Section 3.4, if the DL for non-detected result was greater than the maximum detected concentration for an exposure area, that result not included when calculating the EPC. These results are presented in tables F2-7 through F2-13. Inclusion of non-detected data greater than the maximum detected concentrations would likely have resulted in higher risk estimates in the risk characterization of the BHHRA.

6.1.8 Using N-Qualified Data

As discussed in Section 2.2.3 of the RI, data were qualified using the "N" qualifier, when the identity of the analyte is not definitive, generally a result of the presence of an analytical interference in the sample. Examples include samples analyzed for chlorinated pesticide by EPA Method 8081A, which were most commonly N-qualified as a result of analytical interference due to the presence of PCBs in the samples. These N-qualified data were used in the BHHRA for calculating EPCs in fish and/or clam tissue. The following COPCs were included based solely using N-qualified data, and had estimated cancer risks greater than 1 x 10^{-6} or HQs greater than 1:

- alpha-Hexachlorocyclohexane (fish tissue)
- beta-hexachlorocyclohexane (fish tissue)
- gamma-hexachlorocyclohexane (fish tissue)
- Heptachlor epoxide (clam tissue)

Both the identity and concentration of these contaminants in fish/clam tissue is uncertain, and they were not detected in abiotic media at levels posing risk to human health. A discussion of how EPCs and risk estimates would change for adult consumption of whole body fish tissue and shellfish tissue if N-qualified data were not included in the BHHRA dataset is presented in Attachment F6.

6.1.9 Using One-Half The Detection Limit for Non-Detect Results in Summed Analytes

When data are presented as summed values (e.g., total PCB congeners), one-half the detection limit was used as a surrogate concentration when calculating the summed value for those specific analytes reported as non-detect. Use of one-half the detection limit assumes that there is equal probability that the actual concentration in the sample may be greater or less than the surrogate value. In general, the detection limits for non-detect results were low relative to detected concentrations. In addition, by only including those contaminants that were determined to be present in a given medium, the uncertainty associated with the use of non-detect results was minimized.

6.1.10 Contaminants That Were Not Analyzed in Certain Samples

Not all fish tissue samples were analyzed for the same suite of analytes. For example, fillet samples collected in Round 1 were analyzed for PCB as Aroclors, but no analysis was done for dioxins and furans. Fillet samples of smallmouth bass and common carp collected in Round 3B were analyzed for PCB, dioxin, and furan congeners. In samples where congeners were analyzed, the risks from the total dioxin TEQ, which is not otherwise measured comprise approximately 1 to 70 percent of the cumulative risks. Therefore, the risks from consumption of black crappie and brown bullhead fillet tissue, which were only analyzed in Round 1, likely underestimate the actual risks particularly in those areas where PCBs and dioxin/furans are the predominant contaminants.

In addition, not all clam samples were analyzed for the same number of contaminants due to limited tissue mass of some composites collected during Round 2. Table 6-8 presents a listing of analyses not completed for specific samples. Additional samples were collected in Round 3B and analyzed for a greater number of specific contaminants. The Round 2 and Round 3B clam tissue data were combined and evaluated on a river-mile basis in the BHHRA. Therefore, EPCs were available for almost all COPCs in each exposure area.

6.1.11 Chemicals That Were Not Included as Analytes

As it is not practical to analyze for every chemical, specific chemicals and chemical groups were chosen for analysis based on an investigation of known or probable sources at in the LWR. However, the chemicals expected to have the potential for significant contributions to risk are included in the risk assessment. The list of chemicals for analysis was determined in collaboration with EPA and its partners and presented in the approved sampling and analysis plan. Subsequently, there has been interest in two additional groups of chemicals: polybrominated diphenyl ethers (PBDEs) and volatile organic compounds (VOCs) in tissue. Risks have subsequently been assessed for exposures to PBDEs in in-water sediment and resident fish tissue, as presented in Attachment F3.

VOCs were not analyzed in tissue or surface water samples. Because of their nature, VOCs are not expected to accumulate in tissue to a sufficient degree to pose significant risk via consumption relative to the other chemicals detected in tissue. Given the magnitude of concentrations and toxicities of other chemicals that were detected in surface water and tissue, VOCs are unlikely to contribute significantly to the overall risks. Therefore, the lack of analysis for VOCs is unlikely to alter the conclusions of the BHHRA.

6.1.12 Chemicals That Were Analyzed But Not Included in BHHRA

Not all detected chemicals were included in the BHHRA. The following analytes were excluded from assessment are either because there are no suspected sources, or the analyte typically only present adverse health risks at high concentrations:

- Ammonia
- Calcium
- Calcium carbonate
- Carbon dioxide
- Chloride
- Ethane
- Ethylene
- Magnesium
- Methane
- Nitrate
- Nitrite
- Oxygen
- Phosphate
- Phosphorus
- Potassium
- Silica
- Sodium
- Sulfate
- Sulfide

6.1.13 Data Not Included in BHHRA due to Collection Date

Data collected after June 2008 were not included in the BHHRA due to the completion schedule of the RI/FS. These data sets are discussed in the Portland Harbor RI Report, and include a number of in-water sediment samples. However, due to the large spatial coverage of the existing in-water sediment BHHRA dataset, this uncertainty is not expected to affect the overall conclusions of the BHHRA.

6.1.14 Compositing Methods for Biota and Beach Sediment Sampling

Compositing schemes were developed to be representative of the medium sampled and to be representative of each exposure unit. Fish were composited based on an estimate of the average home range for each species (ODFW 2005). The home ranges for common carp and brown bullhead may be as large or larger than the Study Area, the home range for bass may be larger or smaller than the one mile assumed in the BHHRA. For example, bass may only reside on one side of a river mile reach instead of throughout the one mile reach on both sides of the river. Smallmouth bass were composited on a river mile basis, while black crappie, brown bullhead, and carp were composited on a fishing zone basis. Fishing zones for brown bullhead and black crappie were from RM 3-6 and RM 6-9; fishing zones for common carp were from RM 0-4, RM 4-8 and RM 8-12. However, the compositing scheme represents only an approximation of the home ranges of the fish collected, and typically consisted of five individual fish. Replicate composite samples were collected, and risks were evaluated using both the composite samples as well as on a Study Area-wide basis. Where contaminants are evaluated on a harbor-wide basis and/or specific species are wide-ranging, this process is not likely to have an appreciable effect on the conclusions of the BHHRA. However, where samples are composited over an area larger than the actual home range of specific fish species, the result may either over- or underestimate risks, depending on the distribution of contaminant concentrations in the area over which samples are composited. For example, the highest DDx concentrations are located on the west side of the river at RM 7.5, while the EPC for smallmouth bass at that river mile combined data collected from both sides of the river.

Beach sediment was composited on a beach by beach basis, resulting in a single sample result for each exposure area. Uncertainty stems from this compositing scheme because the results of the risk evaluation are dependent on a single sample. Composite samples are generally assumed to represent the area from which the individual samples of the composite were taken, but an unrepresentative individual sample (e.g., one representing extremely localized or ephemeral contamination) used in the composite could significantly bias the composite results. The compositing scheme for beaches results in risk evaluation based on a single sample at a single point in time. If a beach was found to pose an unacceptable risk, additional samples at that beach might be warranted. However, all of the beach sediment exposure scenarios ranged from 8×10^{-9} to 9×10^{-5}, which are below or within the target risk range of 1×10^{-4} to1 $\times 10^{-6}$.

6.1.15 Mislabeling of Smallmouth Bass Fish Sample

One smallmouth bass sample collected from the west side of RM 11 (LW3-SB11W-11) during the Round 3 sampling event was incorrectly recorded as LW3-SB11E-01

(RM 11 east) at the field lab. This fish became part of the final LW3-SB11E-C00B and LW3-SB11E-C00F composite samples, which are the body and fillet composites from RM 11 east. Fish SB11E-01 (actually from SB11W) accounted for 15 percent of both sample types on a mass basis. However, since smallmouth bass exposure areas were assessed on a river mile basis, the data from RM 11E and RM 11W were included in the same EPC calculations, and the effects of this uncertainty are not expected to affect the conclusions of this BHHRA.

6.2 EXPOSURE ASSESSMENT

Uncertainties that arise during the exposure assessment can typically have some of the greatest effect on risk estimates. The following subsections address uncertainties associated with exposure models, exposure scenarios, exposure factors, and EPCs used in the risk estimates.

6.2.1 Subsurface Sediment Exposure

A complete exposure pathway requires the presence of a retention or transport medium, an exposure point, and an exposure route. Subsurface sediment was not considered an exposure medium in the BHHRA because it was assumed that potential human contact with river sediment below 30 cm in depth was unlikely, or that if it does occur, the frequency and extent would be minimal. Situations which may result in human exposure to subsurface include: potential scouring, natural hydraulic events that are not well understood, future development of near-shore and upland properties, maintenance of the navigation channel, ports, and docks, placement and maintenance of cable and pipe crossings, pilings and dolphins, anchoring and spudding of vessels, and exposure to propeller wash from vessels. Due to the low potential of exposure to subsurface sediment, the estimates presented in the BHHRA are considered sufficiently representative of baseline exposures.

6.2.2 Potential Exposure Scenarios

Some of the key uncertainties associated with the exposure scenarios evaluated in the BHHRA are discussed in the following subsections.

6.2.2.1 Shellfish Consumption

A commercial crayfish fishery exists in the LWR, and crayfish landings must be reported to ODFW by water body and county. Per ODFW, the crayfish fishery in the LWR is not considered a large fishery (Grooms 2008), and no commercial crayfish landings were reported for the Willamette River in Multnomah County from 2005 to 2007. DHS had previously received information from ODFW indicating that an average of 4,300 pounds of crayfish were harvested commercially from the portion of the Willamette River within Multnomah County each of the five years from 1997-2001. In addition to this historical commercial crayfish harvesting, DHS occasionally receives calls from citizens who are interested in harvesting crayfish from local waters who are interested in fish advisory information. According to a member of the Oregon Bass and Panfish club, crayfish traps are placed in the Portland Harbor Superfund Site boundaries and collected for bait and possibly consumption (ATSDR 2006). It is not known to what extent non-commercial harvesting of crayfish occurs within the Study Area, if at all, or whether those crayfish are consumed and/or used for bait.

Evidence of current consumption of freshwater clams from Portland Harbor is limited. According to a project conducted by the Linnton Community Center (Wagner 2004), transients reportedly consume clams from the river on a limited and infrequent basis. As part of the project, conversations were conducted with transients about their consumption of fish or shellfish from the Willamette River. These conversations were not conducted by a trained individual and were not documented. Transients reported consuming various fish species, as well as crayfish and clams, and many indicated that they were in the area temporarily, move from location to location frequently, or have variable diets based on what is easily available. Assuming that clam consumption occurs, the Linnton Community Center project suggests that it does not occur on an ongoing basis within the Study Area. DEQ and EPA staff have occasionally received calls from individuals who claim to have harvested clams and are inquiring whether consumption is safe, and individuals have been observed harvesting clams from the shore in Portland. However, the predominant species found in the LWR during sampling events were Asian clams (*Corbicula*), which are an invasive, non-native species. Oregon law (OAR 635–056–0050) prohibits the possession, transportation, and sale of non-native wildlife, and the actual extent to which freshwater clams or other shellfish are currently harvested from Portland Harbor and consumed is not known.

6.2.2.2 Wet Suit Divers

Commercial diving companies in the Portland area were contacted to develop a better understanding of potential diver exposures within the Study Area. All of the diving companies that were contacted indicated that the standard of practice for commercial divers is the use of dry suits and helmets when diving in the LWR (Hutton 2008, Johns 2008, and Burch 2008). EPA Region 10 reported observing divers in wet suits and with regulators that are held with the diver's teeth within the Study Area. An evaluation was also performed of helmet diving with use of a neck dam, which allows can allow water to leak into the diving helmet. Commercial divers as recently as 2009 have been observed using techniques to don a diving helmet which increase exposure (Sheldrake personal communication with RSS, 2009, DEQ, 2008). The observed wet suit divers were performing environmental investigation and remedial activities, which are not activities evaluated as part of a commercial diver scenario. Also, it is not known whether the individuals who were observed diving in wet suits on specific occasions are diving within the Study Area on a regular basis, as they do not work for the commercial diving companies in the Portland area. Recreational diving also takes place in Portland Harbor (Oregon Public Broadcasting Think Out Loud, "Are you going to swim in that?" August 22, 2008). Therefore, including a wet suit diver scenario with associated ingestion from use of a recreational type regulator, rather than a full face mask or diving helmet, and full body dermal exposure in this BHHRA (in addition to a dry suit diver scenario) is a conservative approach.

6.2.2.3 Domestic Water Use

The evaluation of surface water as a domestic water source is based on the assumption that surface water is drawn from the Study Area. Within the Study Area, the LWR is not currently used as a domestic water source. According to the City of Portland, the primary domestic water source for Portland is the Bull Run watershed, which is supplemented by a groundwater supply from the Columbia South Shore Well Field (City of Portland 2008). In addition, the Willamette River was determined not to be a viable water source for future water demands through 2030 (City of Portland 2008). Additionally, although domestic water supply is a designated beneficial use of the Willamette River, OAR 340-041-0340 Table 340A defines the beneficial use only with adequate pretreatment. Thus, it is unlikely that individuals at households receiving water from the city would be exposed to contaminants at concentrations greater than the MCL. As presented in Section 5.2.8, cPAHs and MCPP are the only COPCs that posed an estimated cancer risk greater than 1 x 10^{-4} (cPAHs) or a noncancer hazard greater than 1 (MCPP). The uncertainties associated with assessing dermal exposures to dissolved PAHs are discussed further in Section 6.2.4.2. Although there is no MCL established for MCPP, the associated HQ is greater than 1 at only one of the locations evaluated, W035, located at RM 8.5, where the estimated hazard is 2.

6.2.3 Potentially Complete and Insignificant Exposure Pathways

Exposure pathways that have been determined to be potentially complete and insignificant were not evaluated further in this BHHRA. As described in Section 3.2, these exposure pathways have a "source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur; however, the pathway is considered a negligible contributor to the overall risk." The exposure pathways identified as potentially complete and insignificant were related to Willamette River surface water exposures to populations evaluated in this BHHRA. Ingestion and dermal absorption of chemicals from surface water were quantitatively evaluated for the populations that are expected to have the most frequent contact with surface water. Surface water exposures were not evaluated were for dockside workers, in-water workers, tribal fishers, and fishers.

The BHHRA identified and evaluated the exposure pathways that were expected to result in the most significant exposure to COPCs in the Study Area. The magnitude of exposures experienced by populations for these exposure pathways are typically expected to be much greater than that expected for the exposure pathways identified as "insignificant." Thus, the assessment of risk to populations from exposure pathways that were quantitatively evaluated in this BHHRA would be adequately protective of exposed populations in the Study Area. However, the uncertainty associated with not directly evaluating exposure pathways considered insignificant could underestimate risks for the Study Area. Due to the low potential of exposure for these pathways, this uncertainty is not expected to impact the conclusions of this BHHRA.

6.2.4 Exposure Factors

Assumptions about exposure factors typically result in uncertainty in any risk assessment. As discussed previously, the scenarios evaluated are representative of exposures that could occur in the Study Area under either current or future conditions. RME and CT values were used for the exposure scenarios to help assess the overall effect that variability in each of the exposure assumptions has on the risk estimates. The range of risk estimates between these two exposure scenarios provides a measure of the uncertainty surrounding these estimates.

A range of ingestion rates for fish consumption were used to evaluate variability on the risk estimates, thus the resulting risks in this BHHRA represent a range of possible outcomes, including estimates that may be representative of the upper range of plausible exposures.

The following exposure factor uncertainties have been identified and analyzed further to determine the potential effects on the risk estimates:

6.2.4.1 Exposure Parameters for Sediment Exposure Scenarios

The parameters used in the BHHRA to evaluate beach and in-water sediment exposure used were intended to provide conservative estimates based on potential uses in the Study Area.

Beach areas that are accessible to the general public were identified as potential human use areas, even though it is not known whether recreational beach use actually occurs at these locations, and the extent to which the beach may be used and the nature of the contact with sediments is unknown. Future changes in land use may make some beach areas more- or less-accessible to the general public, which increases uncertainty about future exposure. When evaluating in-water sediment, each on-half mile river mile segment on each side of the navigation channel was considered a potential exposure area for all in-water sediment exposure scenarios, regardless of the feasibility or practicality of use of the area. Information from this approach can be used to inform the public about relative risks throughout the river and can help focus the feasibility study.

There are uncertainties associated in the selection of the exposure duration, frequency, and intake parameters used to evaluate both beach and in-water sediment exposures. These scenarios assume long-term repeated use of the same beach or one-half mile river mile segment, which may not accurately reflect actual use practices.

The exposure frequencies evaluated range from 94 days/year up to 250 days/year. Default intake parameters for soil exposure were generally used; however, to account for an assumed greater moisture content of beach sediments, the dermal adherence factor used to evaluate child recreational beach exposure was 10-fold greater than the default for soil. Consistent with EPA guidance (2004), only those compounds or classes of compounds for which dermal absorption factors are available were quantitatively evaluated via dermal contact exposure. COPCs for which dermal absorption factors were not available were not quantitatively evaluated, as dermal absorption was essentially assumed to be zero. However, as the majority of COPCs were quantitatively evaluated, this uncertainty does not substantially change the conclusions of this BHHRA. Most of the uncertainties associated with the sediment exposure parameters are likely to overestimate the risks associated with direct exposure to sediment.

6.2.4.2 Exposure Parameters for Surface Water and Groundwater Seep Exposure Scenarios

Although dermal absorption of PAHs from water was quantitatively evaluated in the BHHRA, the dermal permeability coefficient (K_p) falls outside of the effective predictive domain (EPD) for a number of the PAHs, including the following:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Indeno(1,2,3-cd)pyrene
- Dibenzo(a,h)anthracene

EPA dermal assessment guidance (EPA 2004) states that "although the methodology [for predicting the absorbed dose per event] can be used to predict dermal exposures and risk to contaminants in water outside the EPD, there appears to be greater uncertainty for these contaminants." The range of uncertainty associated with the Kp value can be several orders of magnitude. For instance, the predicted Kp value recommended by EPA (2004) for benzo(a)pyrene is 0.7 centimeters per hour (cm/hr), while the range of predicted Kp values presented by EPA (2004) is 0.024 cm/hr (95 percent lower confidence level) to 20 cm/hr (95 percent upper confidence level). This uncertainty could result in over-estimation or under-estimation of risk from exposure to surface water. With the exception of arsenic, the only exceedances of 1×10^{-6} risk from surface water scenarios are the result of dermal exposure to PAHs in surface water. However, all of the surface water exposure scenarios were below or within the target risk range of 1×10^{-4} to 1×10^{-6}.

6.2.4.3 Exposure Parameters for Fish/Shellfish Consumption Scenarios

Site-specific information regarding fish consumption is not available for Portland Harbor. In the absence of specific data, fish consumption data representative from several sources was considered and selected as being representative of the general population of the greater Portland area, as well as that portion of the population that actively fishes the Lower Willamette and utilizes fish from the river as a partial source of food. However, the rates presented in the CSFII study represent per capita consumption rates rather than true long-term averaged consumption rates. Further, the large range between the percentile values is indicative of substantial variability in the underlying data. For example, consumption rates consumers are 200 g/day at the 90th percentile and 506 g/day at the 99th percentile. The consumption rate for consumers and non-consumers is approximately 18 g/day at the 90th percentile and 142 g/day at the 99th percentile. As discussed in Section 3.5.9.6, the RME consumption rate selected for recreational fishers of 73 g/day is based on data from the Columbia Slough study. That study was a creel survey, and the representativeness of the rate is dependent on several factors, including but not limited to:

- Willingness of anglers to participate
- Communication. If a substantial number of anglers consist of 1st or 2nd generation ethnic minorities, then language may be a barrier.
- Discrepancy between individuals who catch fish and those who prepare meals. Men generally fish but women generally prepare seafood and are much more familiar with the mass of seafood consumed.
- Difficulty in translating from the items inspected in an angler's basket to portion sizes and amounts consumed, since this requires assumptions about edible portions and cleaning factors.
- Lack of a random or representative sample. Interviewers can only speak with who they encounter.
- Timing and seasonality of interviews.
- Weather conditions may bias the results of any day's interviews.

In addition to the consumption rates, uncertainty also exists with respect to the relative percentage of the diet of obtained from the Study Area versus other nearby sources of fish, and the degree to which different methods of preparation and cooking may reduce concentrations of persistent lipophilic contaminants.

Uncertainties associated with tribal consumption rates largely relate to limitations inherent in the CRTFIC consumption survey on which the consumption rates used in the BHHRA are based. These consumption rates may be biased low for tribal members because:

- Tribal members who have a traditional lifestyle (and likely a higher consumption rate) would have been unlikely to travel to the tribal offices that were used for administering the CRITFC fish consumption interviews.

- The fish consumption rates for some tribal members that were perceived as being outliers (consumption rates were too high) were dropped from the CRITFC data before the consumption rates were calculated.
- Current fish consumption rates may be suppressed and, therefore, do not reflect the potential of the higher consumption rates if fishery resources improved or if contaminant concentrations in the water body decrease.

Conversely, conservative assumptions were used with respect to exposure frequency and duration, as well as the relative contribution of fish from the Lower Willamette to the overall tribal diet. According to the CRITFC survey, none of the respondents fished the Willamette River for resident fish and at most, approximately 4 percent fished the Willamette for anadromous fish. However, future use of the site by tribal members may change if fishery resources improved.

Information regarding consumption of shellfish from the Study Area relies in part from information obtained from a community project sponsored by the Linnton Community Center, as discussed in Section 3.3.6. However, it is not known to what extent shellfish consumption actually occurs. Because site-specific shellfish consumption rates are not available, nationwide CSFII (USDA 1998) shellfish consumption data were used. As with the rates for fish consumption, these are based on per capita consumption rates from the general population. In the nationwide survey, shrimp accounted for more than 80 percent of the shellfish consumed, crayfish accounted for less than one percent of diet, and freshwater clams were not included in the nationwide survey. It is not known to what extent fishers substitute alternative local types of shellfish. However, the mean nationwide shellfish consumption rate from freshwater sources is 0.01 g/day; upper percentiles for freshwater shellfish consumption rates are not available (EPA 2002b).

The upper and lower bounds of uncertainty relating to fish the shellfish consumption is discussed in Attachment F6.

6.2.4.4 Assumptions about a Multi-Species Diet

Uncertainties exist in the assumptions about the relative composition of a multi-species diet. The non-tribal multi-species diet assumes equal proportions of all four resident fish species, the tribal multi-species diet assumed equal proportions of the four resident fish species, as well as dietary percentages of salmon, lamprey, and sturgeon derived from the CRITFC survey. Variations of these dietary assumptions would result in different risk estimates. Because the risks from consumption of the individual species that make up the multi-species diet were evaluated separately, the range of risks from fish consumption scenarios encompasses the potential variations in the multi-species diet. The range of the magnitude of these risks generally less than an order of magnitude, and is discussed further in Attachment F6. The magnitude in the difference of risk estimates based on diet composition shows that this uncertainty could result in over or under-estimation of actual risks from a multi-species diet.

6.2.5 Exposure Point Concentrations

The following uncertainties related to calculation of EPCs for this risk assessment were analyzed further to determine the potential effects on the risk estimates.

6.2.5.1 Using 5-10 Samples to Calculate the 95 percent UCL on the Mean

Data sets with fewer than 10 samples per exposure area generally provide poor estimates of the mean concentration, defined as a large difference between the sample mean and the 95 percent UCL. In general, the UCL approaches the true mean as more samples are included in the calculation The Study Area-wide fish tissue EPCs that were calculated as 95 percent UCL on the mean using less than 10 samples, included EPCs for whole body brown bullhead and fillet common carp. The EPCs for the individual exposure points for whole body brown bullhead and fillet common carp were up to two times higher than the Study Area-wide EPCs, as discussed in Attachment F6.

6.2.5.2 Nondetects Greater than Maximum Detected Concentrations

Consistent with EPA guidance, analytical results reported as non-detect for which the detection limit was greater than the maximum detected concentration in a given exposure area were removed from the dataset prior to calculation of the 95 percent UCL. These sample identifications, detection limits, and associated maximum concentrations are listed by media and exposure area in the tables in Attachment F2. If the actual concentrations were closer to the detection limit for surface water and in-water sediment, the risk estimates would still be less than 1 x 10^{-6}.

6.2.5.3 Using the Maximum Concentration to Represent Exposure

The maximum concentration was used in instances where there were either less than five detected results or fives samples for a given analyte and exposure area, including EPCs calculated to represent Study Area-wide exposure. Use of the maximum concentration to represent exposure occurred for all media, and occurred most frequently for the fish and shellfish consumption scenarios. Contaminants and exposure points for which the maximum detected concentration was used instead of a 95 percent UCL on the mean are presented in the exposure point concentration tables in Section 3. In some cases, the maximum concentration for a contaminant was anomalously high, and may not be representative of tissue concentrations resulting from exposure to CERCLA-related contamination within the Study Area.

Generally, the ratios between the maximum and minimum detected concentrations are less than 3. For in-water sediments, the ratios are less than 4. When comparisons are made within an exposure area for biota, the majority of the ratios of the 95 percent UCL/maximum EPCs to the mean are equal to or less than 2, and the remaining ratios are less than 4. A more in-depth analysis of scenarios for which using the maximum concentration to represent exposure significantly affected the result of the risk estimate, and consequently which chemicals were designated as contaminants potentially posing unacceptable risks for a scenario, is provided in Attachment F6.

EPA's UCL guidance (EPA 2002) notes that that defaulting to the maximum observed concentration may not be protective when sample sizes are very small because the observed maximum may be smaller than the population mean.

6.2.5.4 Possible Effects of Preparation and Cooking Methods

Cooking and preparation methods of fish tissue can change the concentration of lipophilic contaminants in fish tissues; EPA (1997b) states that "cleaning and cooking techniques may reduce the levels of some chemical pollutants in the fish." PCBs tend to concentrate in fatty tissues. Trimming away fatty tissues, including the skin, may reduce the exposure to PCBs. Removing the skin can reduce PCB concentrations in raw fillet by 50 percent by (EPA 2000c). Cooking can also reduce the concentrations as much as 87 percent, depending on the method (Wilson et al. 1998). However, one study showed a net gain in PCB concentrations after cooking (EPA 2000c). The potential for reduction in PCB concentrations due to cooking is subject to a substantial degree of variability, and some consumption practices make use of whole fish, reductions in PCB concentrations were not considered quantitatively in the risk assessment.

6.2.5.5 Assumptions about Arsenic Speciation

Tissue concentrations of arsenic were reported as total arsenic, while EPA toxicity criteria is based on inorganic arsenic. A study conducted on the middle Willamette River (EVS 2000) measured composites of resident fish (largescale sucker, carp, smallmouth bass, and northern pikeminnow) from a 45-mile section of the iver extending from the Willamette (River Mile 26.5) to Wheatland Ferry (River Mile 72). Total arsenic and inorganic arsenic concentrations were determined in composites of whole body, fillet with skin, and composites of that portion of the fish remaining after removing fillets. Percent inorganic arsenic ranged from 2 percent (carp) to 13.3 percent (sucker). The average percent of inorganic arsenic was 4.2 percent for the carp and 3.8 percent for the smallmouth bass. Consistent with the recommendation in the Columbia River Basin Fish Contaminant Survey (EPA 2002e), the EPC for inorganic arsenic was estimated as 10 percent of the total arsenic detected in tissue.

Inorganic arsenic in clams was found to range as high as 50 percent of total arsenic in data collected in the Lower Duwamish River. However, the Lower Duwamish is an estuarine system, while the Lower Willamette in Portland Harbor is freshwater. Since the actual percent of arsenic that is inorganic in clam tissue from the Study Area is unknown, this results in uncertainty in the estimate of inorganic arsenic EPCs in shellfish. The clam tissue data collected from the Study Area was evaluated to determine whether a higher percentage of inorganic arsenic might have a significant effect on overall risk from the consumption of clam tissue:

- All of the arsenic concentrations in clam tissue are within a factor of 2. In addition, the arsenic concentrations in clams are normally distributed.
- Due to the narrow range of arsenic concentrations, the risks from consumption of clams are within a factor of 2 throughout the Study Area.
- If inorganic arsenic is assumed to be 50 percent of the total arsenic rather than the assumption of 10 percent used in the BHHRA, the cumulative risks from consumption of clams increase by a factor of 1.1 to 1.3. Arsenic is not the primary contributor to risks from consumption of clams.

Given all of the other uncertainties associated with risks from clam consumption, the inorganic arsenic assumption is a minor uncertainty with minimal effect on the overall risk estimates.

Although arsenic resulted in risks greater than 1×10^{-6} for some of the fish consumption scenarios, the contribution of arsenic to the cumulative risk was substantially less than that from PCBs. Therefore, the assumptions about inorganic arsenic are not likely to affect the overall conclusions of the BHHRA.

6.2.5.6 Polychlorinated Biphenyls

PCBs were analyzed as Aroclors in some media and as individual PCB congeners in others. This introduces some uncertainty when comparing cumulative risk across media. Congener analysis may provide a more accurate measure of PCBs in environmental samples than does the Aroclor analysis. Although most PCBs may have originally entered the environment as technical Aroclor mixtures, environmental processes, such as weathering and bioaccumulation, may have led to changes in the congener distributions in environmental media such that they no longer closely match the technical Aroclor mixtures used as standards in the laboratory analysis, leading to inaccuracies in quantitation.

The results for PCBs in whole body tissue samples analyzed for both PCBs as Aroclors and as individual PCB congeners were qualitatively compared to evaluate correlations associated with the use of Aroclor data. Windward (2005) analyzed fish tissue from the Lower Duwamish Waterway as PCB Aroclors and as individual PCB congeners. The PCB Aroclor data and PCB congener data were significantly correlated for both fillet and whole body tissue. It should be noted that the Lower Duwamish Waterway is not freshwater, and different species were assessed in the Lower Duwamish study compared to Portland Harbor. These correlations suggest that PCB Aroclor data may be used in the place of congener data if congener data are not available.

When available, PCB congener data were included in cumulative risk sums for tissue because differences in bioaccumulation in addition to weathering results in greater uncertainty in the PCB Aroclor analysis for tissue. However, fillet tissue collected in Round 1 was analyzed for PCB Aroclors only, Round 3 smallmouth bass and common carp samples were analyzed for PCB congeners only. Because PCB congener data are available for smallmouth bass and common carp fillet tissue, cumulative risks for exposure to fillet tissue from ingestion include only the most recent tissue data for these two species. This introduces uncertainty to the cumulative risk estimates for exposure to fillet tissue when comparing risks across all four resident species.

PCB Aroclor data were included in cumulative risk sums for sediment because the PCB Aroclor dataset is larger than the congener dataset.

PCB congener data were included in the risk evaluation for surface water because the PCB Aroclor data was derived from the results of the congener analysis for the samples used in the risk characterization of this BHHRA. Total PCB congeners did not screen in as COPCs for any surface water scenarios. If PCB Aroclor data from the surface water dataset were used in the COPC screening, PCBs would still not be considered a COPC for any surface water scenarios.

When PCB congener data were used, the total PCB concentration was adjusted by subtracting the concentrations of coplanar PCBs from the total PCB concentration. This was done for purposes of estimating cancer risks because the coplanar PCBs were evaluated separately for the cancer endpoint.

6.2.5.7 Bioavailability of Chemicals

The toxicity values used in the risk assessment are often based on laboratory studies in which the chemical is administered in a controlled setting via food or water. Absorption from environmental media may be lower than that observed in the laboratory. Studies have shown that conditions in environmental media (e.g., pH, organic carbon content) can affect the bioavailability of a chemical (Ruby et al. 1999, Pu et al. 2003, Saghir et al. 2007). If the bioavailability of a chemical in a given environmental medium is less than that in the laboratory study used to derive the toxicity value, the risk assessment will overestimate the exposure to that chemical in that medium. The National Research Council has recommended that consideration of bioavailability be incorporated in decision-making at sites (National Academy of Sciences 2003). While site-specific information on the bioavailability of chemicals in sediment is not available, it is important to recognize that there is uncertainty associated with not incorporating bioavailability into the risk estimates, especially related to sediment-associated chemicals.

6.2.5.8 Exposure Areas for Consumption of Smallmouth Bass

Exposure via consumption of smallmouth bass was evaluated on a river mile basis. Uncertainties associated with the home range of smallmouth bass are discussed in Section 6.1.13. In Round 1, samples were composited on a per river mile basis, Round 3, samples were composited on a per river mile basis for each side of river. The Round 1 and Round 3 results were combined, and the EPC thus represents an exposure area of one river mile. A study by ODFW (ODFW 2005) that included tracking the movement of smallmouth bass in the Lower Willamette indicated that their home range is typically between 0.1 and 1.2 km, and they are most frequently found in near-shore areas.

Figure 6-1 displays the ratios of concentrations of DDT, DDE, DDD, cPAH, dioxin/furan TEQ, and PCB congeners detected in composite smallmouth bass samples collected at the east side of the river mile compared to concentrations for those detected in composite samples collected at the west side of the river mile. At RM 8, 9, and 10, the ratios are all less than 1, indicating concentrations on the east side of the river are generally less than concentrations on the west side of the river. For the remaining river miles, some ratios exceed one. East to west side concentration ratios for PCBs at river mile 11 are highest of any river mile evaluated. As previously discussed in Section 6.1.14, that a fish from RM 11W was included in the composite for RM 11E due to a mislabeling of the sample. Due to the low number of samples for each exposure area, the maximum detected concentration from either side of the river was typically used as the RME EPC for the river mile exposure areas. In addition, the area over which fishing occurs should also be considered. Given an exposure duration of 30 to 70 years, it is possible that fish would be collected over an area greater than a single river mile. Therefore, use of an exposure area consisting of a single river mile for evaluating consumption of smallmouth bass is generally health protective and unlikely to underestimate risks.

6.2.5.9 EPCs in Surface Water for Recreational Beach Users

Only data collected from the low water sampling event was used to assess recreational exposures to surface water, in order to represent surface water conditions during the time of year when most frequent recreational use occurs. There is some uncertainty in the representativeness of this dataset for surface water conditions for recreational users.

Because exposure to surface water by transients can occur throughout the year, data from sampling events during three seasons of the year were used for this scenario and can be used to assess the representativeness of the single low water sampling event. Arsenic was the only surface water COPC detected in recreational exposure areas. The Study Area-wide average total arsenic concentration for transient exposure to surface water, using year-round data, is 0.48 µg/l. The Study Area-wide average total arsenic concentration for recreational beach user exposure to surface water, using low flow data, is 0.51 µg/l. Given the similarity of these results, the uncertainty associated with the recreational beach user surface water dataset should not affect the conclusions of this BHHRA.

6.3 TOXICITY ASSESSMENT

The results of animal studies are often used to predict the potential human health effects of a chemical. Extrapolation of toxicological data from animal studies to humans is one of the largest sources of uncertainty in evaluating toxicity. Much of the toxicity information used in this BHHRA comes from EPA's Integrated Risk Information System (IRIS), which states the following on its website:

> In general IRIS values cannot be validly used to accurately predict the incidence of human disease or the type of effects that chemical exposures have on humans. This is due to the numerous uncertainties involved in risk assessment, including those associated with extrapolations from animal data to humans and from high experimental doses to lower environmental exposures. The organs affected and the type of adverse effect resulting from chemical exposure may differ between study animals and humans. In addition, many factors besides exposure to a chemical influence the occurrence and extent of human disease (EPA 2010b, http://www.epa.gov/iris/limits.htm).

EPA typically applies uncertainty factors, typically a factor 10, when deriving reference doses, to account for limitations in the data. These limitations include variation in susceptibility among the members of the human population, uncertainty in extrapolating animal data to humans, uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure, uncertainty in extrapolating from a LOAEL rather than from a NOAEL, and uncertainty associated with extrapolation when the database is incomplete. As a result, actual risks within the Study Area are likely to be lower than the estimates calculated in this BHHRA.

In addition, the following specific uncertainties have been identified.

6.3.1 Early Life Exposure to Carcinogens

As discussed in Section 3.5.6, early-in-life susceptibility to carcinogens has long been recognized as a public health concern. EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA 2005b) provides a process to evaluate risks from early-life exposure to carcinogens known to act via a mutagenic mode of action. The only exposure scenarios for which early-life exposures are considered are recreational beach use, fish consumption, and household use of surface water. Of the COPCs identified in the risk assessment, only cPAHs have been identified as mutagenic. The BHHRA did not specifically address early-life exposures in the separate child and adult scenarios. However, increased early-life susceptibility was used to assess risks associated with exposure to PAHs in the combined adult/child scenarios. Therefore, the combined adult/child scenario accounts for the additional potency associated with early life exposures.

6.3.2 Lack of Toxicity Values for Delta-hexachlorocyclohexane, Thallium, and Titanium

Delta-HCH was detected in tissue and in-water sediment. An SF or RfD toxicity value could not be identified for delta-HCH according to the hierarchy of sources of toxicity values recommended for use at Superfund sites (EPA 2003b). Also, an STSC review concluded that the other hexachlorocyclohexane isomers could not be used as surrogates for delta-HCH due to differences in toxicity (EPA 2002d). Potential risk from delta-HCH was not quantitatively evaluated because of the lack of availability of toxicity data.

Thallium was detected in in-water sediment and surface water, and titanium was detected in in-water sediment. Thallium and titanium are naturally occurring elements, and although thallium may have a wide spectrum of effects on humans and animals (EPA 2009a), titanium has been characterized as having extremely low toxicity (Friberg et al 1986). An SF or RfD toxicity value could not be identified for titanium according to the hierarchy of sources of toxicity values recommended for use at Superfund sites (EPA 2003b), and consultation with EPA indicated no surrogate toxicity value was available. Therefore potential risk from exposure to titanium was not quantitatively evaluated in this BHHRA.

6.3.3 Use of Toxicity Values From Surrogate Chemicals for Some Chemicals that Lack Toxicity Values

For some chemicals, if a RfD or SF toxicity value was not available from the recommended hierarchy, a structurally similar chemical was identified as a surrogate. The RfD or SF for the surrogate was selected as the toxicity value and the surrogate chemical was indicated in Section 4. Uncertainty exists in using surrogate chemicals to represent the toxicity of chemicals for which toxicity values are not available. Using surrogate toxicity values could over- or under-estimate risk for a specific chemical.

Based on the results of the BHHRA, the chemicals that exceeded the minimum target cancer risks of 1×10^{-6} or hazard quotient of 1 did not rely on surrogate toxicity values. Therefore, the use of surrogate toxicity values should not affect the conclusions of this BHHRA.

6.3.4 Toxicity Values for Chromium

Chromium was analyzed as total chromium in all media. Although toxicity values exist for both trivalent and hexavalent chromium, hexavalent chromium exhibits greater toxicity that the trivalent form. The reference dose for hexavalent chromium is 0.003 mg/kg-day, versus 1.5 mg/kg-day for trivalent chromium. Hexavalent chromium can be reduced to trivalent chromium in an aqueous environmental medium if an appropriate reducing agent is available, and thus trivalent chromium is more prevalent in the environment (ATSDR 2008). Screening values for trivalent chromium were used in the selection of total chromium as a COPC for in-water sediment, beach sediment, the groundwater seep, and surface water. This is an uncertainty because the trivalent chromium screening level is for insoluble salts.

The highest HQ for chromium from fish consumption was 0.004. Even if a portion of the chromium were present as hexavalent chromium, the HQ would likely still be less than 1. Additionally, EPA currently considers the carcinogenic potential of hexavalent chromium via oral exposure as "cannot be determined." Toxicity criteria derived by the New Jersey Dept. of Environmental Protection was used as a Tier 3 source for evaluating the cancer risks associated with oral exposures to hexavalent chromium.

6.3.5 Toxicity Values for Polychlorinated Biphenyls and Applicability to Environmental Data

The toxicity values for PCBs were applied to both PCB congeners (not including coplanar congeners) and Aroclors. The RfD for PCBs is based on an immunotoxicity endpoint for Aroclor 1254 (EPA 2010b). Several other Aroclors have been detected in media within the Study Area, indicating the mixture of PCBs differs from that used in the study to develop the RfD. The cancer SF for PCBs was derived for PCB mixtures based on administered doses of Aroclors to rats. The PCB mixtures used in the studies included the coplanar PCB congeners (dioxin-like PCBs), and coplanar PCBs may have contributed to the carcinogenicity observed in the study. Because the cancer risk from coplanar PCB congeners was evaluated separately, including both the total PCB and coplanar PCB congener risks in the cumulative cancer risk may result in an overestimate of the cancer risks. Although the potential double counting of PCB mass was corrected for by using the PCB adjusted values, there was no correction for the potential double counting of toxicity of dioxin-like PCBs in the PCB TEQ cancer risk estimate.

PCBs are classified as probable human carcinogens based on adequate dose-response data from studies in rats. However, the human carcinogenicity data are inadequate. Several cohort studies have been conducted that analyzed cancer mortality in workers exposed to PCBs. These studies did not find a conclusive association between PCB exposure and cancer; however they were limited by small sample sizes, brief follow-up periods, and confounding exposures to other potential carcinogens. Therefore, using a cancer SF based on the dose-response observed in rats adds further uncertainties to the cancer risk estimates from PCBs as a dose-response has not been observed in humans.

In addition to the uncertainties with toxicity values for total PCBs, there are uncertainties with the toxicity values for the PCB TEQ, which is evaluated using toxicity values for dioxin and dioxin-like compounds. In its 2001 evaluation of the dioxin reassessment, members of the EPA's Science Advisory Board (SAB) did not reach consensus on the classification of 2,3,7,8-TCDD as a carcinogen (EPA 2001d).

The National Academy of Sciences (NAS 2006) discussed the primary uncertainties with the toxicity values for dioxin and dioxin-like compounds as follows:

- The estimation of risks at doses below the range of existing reliable data may result in an overestimate of risk. An estimate of risk for typical human exposures to dioxin and dioxin like compounds would be lower in a sub-linear extrapolation model than in the linear model that was used to derive the 2,3,7,8-TCDD SF.

- The issue of appropriately assessing the toxicity of various mixtures of these compounds in the environment. The relative concentrations may change over an exposure period, even though the potency of the individual congeners remains constant. The estimated risk in a given sample depends on both potency and concentration.

The above uncertainties apply to risks from dioxins and furans, as well as risks from dioxin-like PCBs.

6.3.6 Adjustment of Oral Toxicity Values for Dermal Absorption

As discussed in Section 4.7, an adjustment was applied to the oral toxicity factor to account for the estimated absorbed dose when evaluating dermal exposures when the following conditions were met:

- The toxicity value derived from the critical study is based on an administered dose (e.g., through diet or by gavage)

- A scientifically defensible database demonstrates the GI absorption of the chemical is less than 50 percent in a medium similar to the one used in the critical study.

EPA (2004) recommends the adjustment of oral toxicity values to reflect dermal absorption only when GI absorption was less than 50 percent, eliminating the need for small adjustments in the oral toxicity value that are not supported by the level of accuracy in the critical studies that are the source of the toxicity values. Organic chemicals are generally well absorbed across the GI tract, absorption of inorganic chemicals is dependent on a number of factors, but is generally less than for organic chemicals. However, in the absence of a specific value for GI absorption, a default of 100 percent was used. EPA 2004 states that assuming 100 percent absorption may underestimate dermal risk for those chemicals that are poorly absorbed because it overestimates the dose at the site of action. The extent of underestimation is proportional to the actual GI absorption. Inorganic COPCs for which the default value of 100 percent GI absorption was used are aluminum, arsenic, boron, cobalt, copper, iron, molybdenum, selenium, thallium, and zinc.

6.4 RISK CHARACTERIZATION

Uncertainties arise during risk characterization due to the methods used in calculating, summing, and presenting risks. The following subsections address uncertainties associated with the risk characterization of this BHHRA.

6.4.1 Endpoint-specific Hazard Indices

In deriving endpoint-specific HIs, only one health endpoint is used for each chemical, even though some chemicals may have a myriad of health effects as exposures increase. As an example, a majority of the non-cancer affect from the site are from PCBs and total TEQ. The endpoint used for deriving the RfD for PCBs is immunotoxicity, while the endpoint used for deriving the RfD for dioxin/furan TEQ and PCB TEQs is reproductive effects. If the reproductive endpoint for PCBs based upon the lowest observed adverse effects level (LOAEL) of 0.02 mg/kg/day is used with the same Uncertainty Factor as the immunological endpoint to derive an RfD for a reproduction endpoint for PCBs, the RfD for reproductive effects would be a factor of 4 greater than the RfD for immunological effects. Using this ratio, the endpoint-specific HI for reproduction for this exposure scenario for PCBs would be 5,000/4 = 1,250. The total HI for reproduction effects, combining HIs for total TEQ (500) and non-dioxin-like PCBs (1,250), would increase from 500 to 1,750. For the chemicals that have the largest non-cancer contribution in the HHRA, there is a possibility of under-predicting non-cancer health effects by using only one endpoint per chemical.

6.4.2 Risks from Cumulative or Overlapping Scenarios

Where multiple exposure scenarios exist for a given population, the risks for each of the exposure scenarios that are considered potentially complete and significant for a given population were summed to estimate the cumulative risks for that population (see Tables 5-199 and 5-200). In calculating the cumulative risks, the maximum cancer risk for each RME scenario was used. This provides a conservative approach, as the same individual may not experience the maximum exposure under more than one exposure scenario. However, due to the fact that risks from one scenario are usually orders of magnitude higher than any other scenario for a given receptor, risks from potential cumulative scenarios should not affect the conclusions of this BHHRA. However, the possible magnitude of uncertainty associated with risks from cumulative or overlapping scenarios is discussed further in Attachment F6.

In addition to cumulative exposure scenarios for a given population, an individual may be a member of multiple exposure populations, and thus overlapping exposure scenarios. Because there are numerous possible combinations of overlapping scenarios due to variations in exposure points and exposure assumptions, a model was not developed to quantitatively evaluate overlapping scenarios in this BHHRA. However, because the risk from fish and shellfish consumption is typically at least 10-fold greater than other exposure pathways, if an individual consumes fish, the relative

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contribution from other exposure scenarios is not likely to contribute significantly to the overall risks for that individual. This BHHRA presents the risks for all of the exposure scenarios, so the risks for a given overlapping scenario could be calculated simply by summing the risks for each of the exposure scenarios that make up the overlapping scenario.

This BHHRA assessed potential risks from exposure to media within the Study Area. Upland sites were not included in this BHHRA. If exposure to upland sites were incorporated with exposures to media within the study, the overall estimate of cumulative risk would likely be higher than the risk estimates in this BHHRA.

6.4.3 Risks from Background

Metals are naturally occurring and may be present in tissue, water, or sediment may not be directly related to contamination. Reported concentrations of arsenic and mercury in samples collected within the Study Area result in estimated risks greater than 1×10^{-6} or an HQ of 1 for one or more of the exposure scenarios evaluated in the BHHRA. Exposure concentrations of arsenic in beach sediment ranged from 0.7 mg/kg to 9.9 mg/kg, within the general range of 7 mg/kg used as a background concentration of arsenic by DEQ (DEQ 2007). Risks from background concentrations of arsenic in beach sediment and surface water are discussed in Section 5 of the BHHRA.

Neither background nor anthropogenic tissue concentrations of COPCs were established for the Study Area. Regional tissue concentrations were measured as part of the Columbia River Basin Fish Contaminant Survey in five anadromous species (Pacific lamprey, smelt, coho salmon, fall and spring Chinook salmon, steelhead) and six resident species (largescale sucker, bridgelip sucker, mountain whitefish, rainbow trout, white sturgeon, walleye). All samples were composites; the size of the individual fish varied with species. Concentrations of certain contaminants are higher in tissue collected within the Study Area than observed in the Columbia River study, and the sources of the regional tissue concentrations are unknown. Consistent with EPA policy, risk estimates were presented in this BHHRA without accounting for contributions from background. However, it is important to recognize that background concentrations may result in unacceptable risk and hazard estimates.

6.4.4 Risks from Lead Exposure

The maximum EPC calculated for lead are associated with a probability of exceeding protective blood lead levels in the fetus of a pregnant woman who consumes fish from the Study Area. This EPC may be attributable to lead in the gut of the fish rather than tissue concentrations. Protective lead concentrations in tissue were estimated using the EPA Adult Lead Methodology (ALM) (EPA 2003c), based on agreements with the EPA to follow the same methodology used in the CRITFC (1994) survey to assess tissue exposures from lead. The ALM as adapted for the Portland Harbor

BHHRA focuses on potential affects to the fetus when considering fish consumption by pregnant women. However, the ALM was developed for evaluating exposure to lead in soil and may not be appropriate to use for fish consumption. Furthermore, the ALM is sensitive to the bioavailability of ingested lead. For purposes of calculating a tissue concentration of lead that is expected to be without adverse effects, the default bioavailability of lead in soil was used, and it is not known whether this is an appropriate assumption for lead in tissue.

6.4.5 Future Risks

This BHHRA estimated current and future risks for exposure within the Study Area, based on known and reasonably anticipated future uses of the Study Area. However, the LWR is a dynamic, industrialized waterway, and if the land uses in certain areas of the Study Area were to change in the future in a manner with the uses considered in the BHHRA, risk and hazard estimates presented here may not be representative of conditions in the future.

6.5 OVERALL ASSESSMENT OF UNCERTAINTY

A summary of the uncertainties and a qualitative classification of their magnitude, their impact on the health protectiveness of the assessment, and their significance to risk management decisions are presented in Table 6-1. For each of the uncertainties identified and discussed in this section, Table 6-1 provides a qualitative assessment (using High, Medium, and Low as descriptors) for each of these properties. In addition, the table presents whether an uncertainty is more likely to over-estimate or under-estimate actual risks from the Study Area. While there are numerous uncertainties identified for this BHHRA, and the cumulative effect of these uncertainties could be significant to the conclusions of the BHHRA, some of these uncertainties would be expected to have more of a significant effect on risk management decisions than other uncertainties. These are identified with a "High" descriptor under the "Significance to Risk Management" column in Table 6-1.

Risk assessments typically include conservative assumptions to minimize the chances of underestimating exposure and/or risks of adverse effects to human health, and therefore potentially underestimating the need for remedial actions. In this BHHRA, conservative assumptions were incorporated into the identification of exposure scenarios, the selection of exposure assumptions, the development of EPCs, and the use of toxicity values. Only a portion of the uncertainties in this BHHRA are quantifiable. Further analysis of the data and review of pertinent published literature provided a possible range of values for some of the uncertainties presented above. The magnitude of these ranges are provided in Attachment F6 and discussed in this Section.

While it is not probable that the maximum values of the uncertainties apply for every tissue consumption exposure scenario and contaminant , this magnitude of uncertainty indicates that risks may actually be less than 1 x 10^{-4} or HI of 1 for certain scenarios.

While conservative, the results of the BHHRA are intended to show the relative risks associated with the exposure scenarios, and which contaminants are contributing the highest percentage of the calculated risks.

7.0 SUMMARY

The overall objective of this BHHRA is to provide an analysis of potential baseline risks to human health from site-related contaminants and help determine the need for remedial actions, provide a basis for determining contaminant concentrations that can remain onsite and still be protective of public health, and provide a basis for comparing the effectiveness of various remedial alternatives.

The populations evaluated in the BHHRA were identified based on human activities currently known to occur within the Study Area or could occur in the future, as described in the Programmatic Work Plan. Populations and associated exposure scenarios that were quantitatively evaluated in this BHHRA include:

- Dockside Workers – Direct exposure to beach sediment
- In-water Workers – Direct exposure to in-water sediment
- Recreational Beach Users – Direct exposure to beach sediment and surface water
- Transients – Direct exposure to beach sediment, surface water, and groundwater seep
- Divers – Direct exposure to in-water sediment and surface water
- Recreational and Subsistence Fishers – Direct exposure to beach or in-water sediment, consumption fish and shellfish
- Tribal Fishers – Direct exposure to beach and in-water sediment, consumption of fish
- Domestic Water Use – Direct exposure to surface water used as a domestic water source
- Infants - Indirect exposure to bioaccumulative contaminants (PCBs, dioxin/furans, DDx, and PDBEs) in environmental media via indirect exposures due to breastfeeding.

7.1 SUMMARY OF RISKS

A comparison of the estimated risks by exposure media can help focus risk management decisions by identifying the media contributing most to the overall human health risks at the Study Area. As discussed in Sections 5, the magnitude of risk varies greatly across the different scenarios. Figures 7-1 and 7-2 display the ranges of total cumulative cancer risk and endpoint-specific HIs, respectively, for each media type, based on CT exposure assumptions for each media evaluated in the BHHRA. Figures 7-3 and 7-4 display the ranges of total cumulative cancer risk and cumulative HIs, respectively, based on RME assumptions. The estimated risks associated with consumption of fish and shellfish are orders of magnitude higher than risks from other scenarios, and exceed a cumulative cancer risk of 1 x 10^{-4} and a HI of 1. Scenarios for which the cumulative estimated cancer risk is greater than 1 x 10^{-4} or the HI is greater than 1 are consumption of fish and shellfish scenarios and direct contact with in-water sediment by tribal and high frequency fishers.

7.2 CONTAMINANTS POTENTIALLY POSING UNACCEPTABLE RISKS

8.0 One role of the BHHRA is to identify those contaminants that pose the greatest risks to current and future receptors, along with the media and exposures routes associated with those risks. This information is used to inform response actions. This section presents the primary contributors to human health risk at the Site. The exposure scenarios and chemicals discussed here represent a subset of the scenarios and contaminants evaluated in this BHHRA.

9.0 Contaminants were identified as potentially posing unacceptable risks if the estimated cancer risk is greater than 1 x 10^{-6} or the HQ is greater than 1 for any of the exposure scenarios evaluated in this BHHRA, regardless of the uncertainties associated with the estimates. Given the uncertainties in the analytical data discussed in Section 6, the preliminary list was further refined to select the final listing of contaminants potentially posing unacceptable risks for this BHHRA. This can assist with the development of the FS by focusing on those scenarios and contaminants associated with the greatest overall risk in the Study Area. While these scenarios and contaminants may be the focus of the remedial analyses, other exposure scenarios and contaminants potentially posing unacceptable risks may still be considered in remedial decisions for the Site.

α-, β-, and γ-Hexachlorocyclohexane and heptachlor were detected in fish tissue only as N-qualified data. Due to retention time issues in the analytical methods used for the Round 1 tissue samples, some of the pesticide tissue data were N-qualified, indicating that the identity of the chemical could not be confirmed. In the subsequent Rounds 2 and 3 sampling events, different analytical methods were used so that the identification of pesticides was not an issue in tissue. EPA guidance (1989) recommends caution in the use of data where there are uncertainties in the identification of contaminants. Therefore, if a chemical was identified as potentially posing unacceptable risks based only on the use of N-qualified data, that chemical is not recommended for further evaluation for potential risks to human health.

The contaminants potentially posing unacceptable risks to human health based on the results of this BHHRA that are recommended for further evaluation for potential risks to human health are presented in Table 7-1.

Only those exposure scenarios and contaminants that resulted in an estimated cancer risk greater than 1 x 10^{-6} or an HQ greater than 1 were considered in identifying the primary contributors to risk. Additional considerations in the selection of contributors included:

- The relative percentage of each contaminant's contribution to the total human health risk consistent with assumptions on exposure areas.
- Uncertainties associated with the exposure scenarios, such as the likelihood of future site use, number of assumptions made in estimating exposure, or level of uncertainty in estimates of exposure variables.
- Frequency of detection, both on a localized basis and Study Area-wide.
- Comparison of risks within the Study Area to risks based on measured regional contaminant concentrations for similar exposure scenarios, indicating background or other anthropogenic sources of chemicals in the region.
- Magnitude of risk greater than EPA's target range for managing cancer risk of 1 x 10^{-4} to 1 x 10^{-6} and noncancer hazard of 1.

The chemicals potentially posing unacceptable risks and the based on the above criteria are discussed below.

9.2.1 Fish Consumption Scenarios

Twenty six COCs (PCBs, dioxins, six metals, Bis-2-ethylhexyl phthalate (BEHP), PAHs, hexachlorobenzene, and seven pesticides) are identified as potentially posing unacceptable risks associated with fish consumption:

- PCBs: Both total PCBs and PCB TEQ based on the magnitude of the estimated risks greater than 1 x 10^{-4}, the overall spatial scale, and the relative contribution to cumulative risk estimates.

- Dioxins/furans: Total dioxin/furan TEQ associated with both localized and Study Area-wide exposures, the magnitude of the risk estimates greater than 1 x 10^{-4}, the overall spatial scale, and the relative contribution to cumulative risk estimates.

- Metals: Antimony, arsenic, mercury, selenium, and zinc were associated with one or more fish consumption exposure scenarios that resulted in a risk estimate that exceeded a cancer risk of 1 x 10^{-6} or HQ of 1.
    - The overall estimated risk estimates for arsenic are greater than 1 x 10^{-4} based on Study Area-wide exposures.
    - The HQ associated with antimony is greater than 1 at RM 10 based on consumption of whole body smallmouth bass tissue.
    - Lead, based on a measured tissue concentration greater than the protective tissue concentrations derived using blood lead models. However, this is due to only a single result of smallmouth bass whole

body tissue collected at RM 10 with anomalously high result, as discussed in Section 6.1.14
- Mercury, based on an HQ of 1 for both localized and Study Area-wide exposures.
- Selenium, based on an HQ of 1 at RM 11 for consumption of smallmouth bass fillet tissue, in a single sample.
- Zinc, based on an HQ of 2 in a single sample of whole body common carp collected from RM 4 to RM 8.

- BEHP, based on cancer risk estimates greater than 1 x 10^{-6} on both a localized and Study Area-wide basis, and RME cancer risk estimates greater than 1 x 10^{-4} and a HQ greater than 1 at RM 4 based on consumption of smallmouth bass for recreational and subsistence fishers.

- <u>PAHs</u>: Benzo(a)anthracene, benzo(a)pyrene, dibenzo(a)anthracene, and total cPAHs, based on cancer risk estimates greater than 1 x 10^{-6}. Cancer risk estimates for total carcinogenic PAH are greater than 1 x 10^{-6} at five river mile segments and Study Area-wide based on consumption of smallmouth bass and for two fishing zones and Study Area-wide based on consumption of common carp.

- <u>Organochlorine Pesticides</u>: Aldrin, dieldrin, heptachlor epoxide, total chlordane, total DDD, total DDE, and total DDT are identified based on estimated cancer risks greater than 1 x 10^{-6} or an HQ of 1.
  - Aldrin, based on cancer risk estimates greater than 1 x 10^{-6} for subsistence fishers at localized areas and Study Area-wide.
  - Dieldrin, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - Heptachlor epoxide, based on estimated cancer risk estimates greater than 1 x 10^{-6} for single-species diet of common carp by subsistence fishers at RM 0 to RM 4.
  - Total chlordane, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - DDD, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - DDE, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis, and an HQ greater than 1 at RM 7, based on consumption of smallmouth bass.

- DDT, based on an estimated cancer risk greater than 1×10^{-6} based on consumption of all fish species on a localized and Study Area-wide basis.
- PDBEs, based on an HQ greater than 1 for consumption of smallmouth bass and carp on a localized basis.

Considering the magnitude and relative contribution to the overall risk estimates, as well as their frequency of detection, PCBs and dioxins/furans are the most significant contributors to risk for fish consumption scenarios. Estimated risks from PCBs and dioxins/furans are greater than 1×10^{-4} or an HQ of 1 for both the CT and RME evaluations at both localized and Study Area-wide exposures. Figure 7-5 illustrates the relative contribution of individual contaminants to cumulative risk estimates based on the Study Area-wide multi-species fish consumption by adult subsistence fishers. PCBs are the primary contributor to the overall risk estimate, and taken together with dioxins/furans expressed as a TEQ account for the majority of the estimated risk. Figure 7-6 shows the relative contributions to the overall risk estimate based on Tribal fish consumption.

PCBs and dioxins/furans have been detected in fish tissue collected outside of the Study Area in both the Willamette and Columbia Rivers. In a risk assessment for the mid-Willamette (EVS 2000), PCB concentrations were found to result in a HQ greater than 1 assuming both a 142 g/day and a 17.5 g/day consumption rate, and an estimated cancer risk greater than 1×10^{-4} for the 142 g/day consumption rate. Dioxins and furans were also found to result in an estimated cancer risk greater than 1×10^{-4} using a 142 g/day consumption rate (non-cancer endpoints were not evaluated for dioxins and furans). In the Columbia River Basin Fish Contaminant Survey (EPA 2002c), the estimated cancer risks associated with PCBs and dioxins/furans were greater than 1×10^{-4} assuming a consumption rate of 142 g/day, and the estimated risk due to PCBs was greater than 1×10^{-4} assuming a consumption rate of 7.5 g/day. While ambient concentrations have not been established for fish tissue, as discussed in Section 6.4.2, regional tissue concentrations may be associated with unacceptable risks from fish consumption, especially at higher consumption rates. While the concentrations in the Study Area are higher than the regional tissue concentrations, the sources of PCBs and dioxins and furans in regional tissue data are unknown, and efforts are underway to reduce regional tissue concentrations.

9.2.2 Shellfish Consumption Scenarios

Seventeen contaminants (PCBs, dioxins, arsenic, PAHs, pentachlorophenol, and five pesticides) were identified as potentially posing unacceptable risks due to consumption of shellfish, based on estimated cancer risks greater than 1×10^{-6} or a HQ of 1:

- PCBs: Total PCBs and PCB TEQs, based on cancer risk estimates greater than 1×10^{-4} and/or HQs greater than 1 for shellfish consumption in localized and Study Area-wide exposures, the magnitude and spatial scale of the risk estimates greater than 1×10^{-4}, their relative contribution to cumulative risk estimates, and their frequency of detection.

- Dioxins/furans: Total dioxin/furan TEQs, based on cancer risk estimates greater than 1×10^{-4} and/or HQs greater than 1 for shellfish consumption in localized and Study Area-wide exposures, the magnitude and spatial scale of the risk estimates greater than 1×10^{-4}, their relative contribution to cumulative risk estimates, and their frequency of detection.

- Arsenic: Based on cancer risk estimates that greater than 1×10^{-6} from clams and crayfish at both consumption rates and on a localized and Study Area-wide scale. No cancer risk estimates exceeded 1×10^{-4}. Though arsenic is identified as a contaminant potentially posing unacceptable risk on both a localized and Study Area-wide spatial scale, concentrations in shellfish tissue are due in part to the contribution of background concentrations.

- cPAHs: Based on cancer risk estimates greater than 1×10^{-6} from both clams and crayfish at both ingestion rates and on a localized and Study Area-wide scale. Cancer risk estimates greater than 1×10^{-4} from clams collected at locations RM 5W and RM 6W and assuming a consumption rate of 18 g/day. cPAHs are considered a primary contributor to risk for the shellfish consumption pathway at those locations because of the magnitude of the risk estimates and their relative contribution to the cumulative risk.

- Pentachlorophenol: Pentachlorophenol was detected only in a single crayfish composite sample collected near RM 8. It was not detected in the remaining 40 shellfish samples. This single detection of pentachlorophenol resulted in a cancer risk estimate within the range of 1×10^{-6} to 1×10^{-4}.

- Organochlorine pesticides: Aldrin, dieldrin, total DDD, total DDE, and total DDT, based on an estimated cancer risk greater than 1×10^{-6} or a HQ of 1.
  - Aldrin, based on an estimated cancer risk greater than 1×10^{-6} for consumption of clams at RM 8W and on a Study Area-wide basis, assuming a consumption rate of 18 g/day.
  - Dieldrin, based on an estimated cancer risk greater than 1×10^{-6} for consumption of clams near RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.
  - Total DDD, based on an estimated cancer risk greater than 1×10^{-6} for consumption of clams near RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.

- Total DDE, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 6W, RM 7W, RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.
- Total DDT, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 6W and RM 7W, assuming a consumption rate of 18 g/day.

Considering the magnitude and relative contribution to the total risk estimates and their frequency of detection, PCBs, dioxins/furans, and cPAHs are the mosti significant contributors to the risk estimates associated with consumption of shellfish. PCBs and dioxins/furans contribute approximately 58 percent and 91 percent, respectively, of the cumulative cancer risk from consumption of clams and crayfish, cPAHs contribute approximately 35 percent and 5 percent, respectively, of the cumulative cancer risk from consumption of clams (undepurated samples) and crayfish. PCBs and dioxins/furans contribute are the most significant contributors to the risk estimates on a Study Area-wide basis, while cPAHs are contribute significantly to the risk estimates on a localized basis at RM 5W and RM 6W.

9.2.3 In-Water Sediment Scenarios

PAHs (primarily benzo[a]pyrene), arsenic, PCBs, and dioxins are identified as contaminants potentially posing unacceptable risk for in-water sediment. PAHs and dioxins are identified for all of the in-water sediment scenarios, arsenic and PCBs were identified for the tribal fisher and high frequency fisher scenarios only. The relative contribution of each contaminant to cumulative cancer risk estimates varied by river mile. Throughout the Study Area, estimated risks from cPAHs and dioxins/furans each contributed approximately 50 percent of the cumulative cancer risk estimate. As previously discussed, cumulative cancer risks associated with arsenic are due in part to naturally occurring concentrations in sediment. Cumulative cancer risks from PCBs are greater than 1 x 10^{-6} at four one-half mile river segments, and from dioxins at two one-half mile segments. Cumulative cancer risks from cPAHs are greater than 1 x 10^{-6} for at 22 one-half mile river segments. Carcinogenic PAHs contribute significantly to risks associated with in-water sediment exposures on a Study Area-wide basis based on the relative magnitude and spatial scale of estimated risks greater than 1 x10^{-4}. PCBs and dioxins contribute significantly to the risk estimates on a localized basis at RM 8.5W (PCBs) and RM 7W (dioxins/furans).

9.2.4 Beach Sediment Scenarios

PAHs (primarily benzo[a]pyrene) and arsenic were identified as potentially posing unacceptable risk in beach sediment. Risks greater than 1 x 10^{-6} associated with exposure to arsenic in beach sediment are due in part to naturally occurring concentrations of arsenic. Risks greater than 1 x 10^{-6} associated with exposure to benzo(a)pyrene was limited to a few locations, with the maximum cumulative cancer risk at beach location 06B025.

9.2.5 Surface Water Scenarios

PAHs are the primary contributor to risks associated with direct contact to surface water. Estimated cancer risks are greater than 1×10^{-4} assuming use of river water as a domestic water source, and greater than 1×10^{-6} for divers at RM 6W. However, as noted in Section 5.2.8, the estimated risks associated with dermal exposure to PAHs in water should be used with caution, as PAHs are not within the Effective Prediction Domain of the model used to estimate the dermally-absorbed dose. Additional risk management considerations during remedy selection should consider the limited spatial scale and degree of uncertainty associated with the diver exposure assumptions. HIs greater than 1 at Multnomah Channel and RM 8.5 were associated with use of river water as a drinking water source.

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Cc: grandinetti.cami@epa.gov[]
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From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Tue 10/23/2012 12:15:54 AM
Subject: Re: Briefing and talking points for Dennis
PH briefing paper dycom cg lc rev oct 22 2012.docx

hi - Deb said to add my comments and she would work on in the am.

I liked Cami's revisions. I only commented on the talking points and basically laid out a framework for some broader points by Dennis to set the tone for the meeting rather than jump head first into the issues we see. Remember, these folks don't live and breathe Superfund so this type of overview should work.... it needs editing as I did not have alot of time to work on this, but it gives you the idea (I hope).

Thank you.

Lori Cohen, Associate Director
Office of Environmental Cleanup
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From: Cami Grandinetti/R10/USEPA/US
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Cc: Chip Humphrey/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA, Sean Sheldrake/R10/USEPA/US@EPA, Lori Cohen/R10/USEPA/US@EPA
Date: 10/22/2012 04:09 PM
Subject: Re: Briefing and talking points for Dennis

It is long--maybe there are things to cut. I moved things around (based on a conversation with Deb and some of my thoughts). It reads messy because I kept redline/strikeout. The words are all mostly the same, I just moved things (sound familiar?).
[attachment "PH briefing paper dycom cg.docx" deleted by Lori Cohen/R10/USEPA/US]

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Date: 10/22/2012 03:22 PM
Subject: Re: Briefing and talking points for Dennis

Here are my comments on the talking points. My first reaction is this is way too much to read. But if we're briefing him on the information in this paper on Wednesday, and then on what is likely to happen in the Blumenauer meeting, using the slide show as a framework, then it would be good for him to have this to read on the way down. Do we also need to have these key messages (appropriately worded) put in the PP presentation?

Also, we need to talk tomorrow on exactly who is going to brief Dennis and what each is going to say.

[attachment "PH briefing paper dycom.doc" deleted by Cami Grandinetti/R10/USEPA/US]

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Cc: Kristine Koch/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA, Sean Sheldrake/R10/USEPA/US@EPA
Date: 10/22/2012 11:32 AM
Subject: Briefing and talking points for Dennis

Deb - here the latest team draft of the briefing paper (status, issues & talking points) for Dennis. Will keep tweaking based on comments in advance of the briefing Wednesday morning. One thing to consider is sorting the messages into those we want Dennis to deliver and others that he'll have ready if issues come up in the discussions - like complaints about previous agreements & what LWG views as EPA changing direction. Our dispute paper has some good language that we can paraphrase and add to the current list.

Chip

[attachment "DM Briefing & Talkng Points 102212.doc" deleted by Cami Grandinetti/R10/USEPA/US]

To: CN=Dan Opalski/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
Bcc: []
From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Tue 12/4/2012 12:55:07 AM
Subject: Re: As discussed.
PH notes from lori.docx

Hi Dan, I have some questions/comments in the attached version.... I did not do a detailed "edit" per se but tried to identify some key places for clarification...hope this helps.

Lori Cohen, Associate Director
Office of Environmental Cleanup
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From: Dan Opalski/R10/USEPA/US
To: Lori Cohen/R10/USEPA/US@EPA
Date: 11/30/2012 02:47 PM
Subject: As discussed.

[attachment "Final Resolution.docx" deleted by Lori Cohen/R10/USEPA/US]

Dan Opalski
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From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Wed 12/12/2012 8:57:40 PM
Subject: per your request
EJ_anal_Duwamish_draft_12_10_2012.docx
(embedded image)

Hi Nina,

Just a quick note to followup to our discussions on Portland Harbor. Rick Albright mentioned your interest in our draft Environmental Justice Analysis for the Lower Duwamish Waterway, and attached for your information is a draft version that has just been sent out to a relatively small group of folks for an informal peer review. This document will go out for public comment with the EPA Proposed Plan for the Lower Duwamish Waterway Site, which is planned for end of February. Keep in mind this is the first EJ analysis of its kind in the Superfund program so we are learning as we go on this project. Also, please do not widely distribute this version as it is still a draft and the public release version will be the one we would rather people focus on - this is really an fyi for you.

I have pasted in the message (see italics) that went to our community members that are reviewing the document as it highlights a few key points about the analysis - just fyi:

Dear Community Partner:

Please find attached the very draft Environmental Justice Analysis for the Lower Duwamish Waterway Cleanup. This is a pre-publication draft meant to elicit questions or concerns that EPA can address before we finalize the draft for publication. Since this is a preliminary draft, I would appreciate it if you would refrain from sharing it with others.

As a reminder, the EJ draft will be published together with the proposed plan for public comment at the end of February, 2013. I am asking for your comments no later than Dec 27, 2012, so that we have time to fully analyze and incorporate the information we receive.

Please note the following for your review:
1. The draft is based upon the LDW Final Feasibility Study Alternatives published in November, 2012, and therefore does not include the proposed plan preferred alternative--this information will be added prior to publication of the draft EJ Analysis in February 2013.

2. The role of the analysis is to highlight potential EJ concerns and identify mitigations for adverse disproportionate impacts as recommendations for consideration in the proposed plan and record of decision. Because of its role and the fact that the remedial alternatives identified in the FS were comparable in methods (differences in extent, but comparable methods), there is a general comparison of alternatives for different environmental and environmental health impacts on the affected community. Because the document would be a lot longer and more redundant if each alternative were to be pulled out in turn and analyzed separately, the alternatives are analyzed together for each possible impact.

3. The analysis does not constitute a full equity analysis, and it instead focuses on identifying adverse disproportionate impacts tied directly to the cleanup.

4. The attached version does not yet contain the figures. The figures are purely illustrative and are in revision - I intend to post them on a website (ftp site) together with the appendices within the next week or so and I will send you the address once they are posted. They are large and hard to read right now.

5. Please send your detailed comments in track changes or as word comments - written summaries will be more difficult to incorporate, although your general thoughts are welcome. If more than one person in your organization is commenting, please comment sequentially and use the same document (consolidate comments).

6. Also, there will be opportunities for more discussion, as we will do multiple engagement events as a part of the proposed plan outreach once the document is officially published for comment in late February.

I look forward to working with you.
Lori

Lori Cohen, Associate Director
Office of Environmental Cleanup
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Environmental Justice Analysis for the Lower Duwamish Waterway Cleanup

DRAFT - December 2012

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Part I: Introduction and Environmental Setting

Introduction and Purpose of the Analysis

The Lower Duwamish Waterway (LDW) is an urban estuary with a long history of alteration and industrialization. The LDW was listed on the National Priorities List (NPL), in 2001.

This environmental justice analysis provides an assessment of the environmental and environmental health the impacts of the proposed Superfund cleanup actions on the affected community. This includes an assessment of the outcomes of proposed Superfund actions on the community, and what environmental justice concerns stem from those proposed actions. Included in this document are data on the burden faced by the community, such as the health status and indicators of health risk in the community, and other exposures to environmental pollution faced by the community living around the LDW. The neighborhoods directly affected include the Georgetown neighborhood east of the waterway, and the South Park neighborhood to the west, along with segments of other neighborhoods that flank the length of the LDW. Other individuals use the river for fishing and recreation.

The LDW also includes local tribes who have a presence in or use resources within the Duwamish River watershed. Two tribes, the federally recognized Muckleshoot and Suquamish tribes, have federal treaty rights along the Duwamish River and usual and accustomed harvesting and gathering areas in and along the LDW. Historically and currently, the Duwamish tribe has lived along and utilized the Duwamish River and its resources, although it does not have federal status and federally established treaty rights.

The purpose of this EJ analysis is to assess the environmental burden faced by the affected community in light of the cleanup alternatives identified for the LDW Superfund Cleanup in the Remedial Investigation/Feasibility Study (RI/FS). The role of the analysis is not to "pick" a cleanup alternative but to:

1. synthesize evidence of and information on the background of the affected community, environmental and health burdens in the community in comparison to reference sites in order to provide a summary of known or identified environmental justice concerns in the community affected by the potential agency action;
2. For the EJ issues identified in 1, determine how the different alternatives compare in ameliorating or exacerbating an environmental justice concern, ;
3. provide input to EPA's selection of the preferred cleanup alternative described in the Proposed Plan and finalized in the Record of Decision;
4. provide recommendations for reducing or eliminating disproportionate adverse impacts if found to the extent possible and practicable; and
5. Identifying uncertainties and data gaps needed to improve the quality of the EJ analysis objectives identified above; and
6. recommend ways to enhance outreach, if there are populations who may require enhanced outreach methods such that they are meaningfully involved in the cleanup process.

The environmental burdens examined within this analysis include risks from resident seafood consumption; risks from direct contact with contaminated sediment; risks from exposure to air pollution; disruption to the community and tribal resources during the cleanup process; socioeconomic impacts of living near a Superfund site before and after cleanup; and the lack of environmental benefits such as greenspace. The recommendations from this analysis will be provided to the Superfund Program for consideration in the development of the Proposed Plan for the Lower Duwamish Superfund Cleanup. The document is organized into two main parts, 1) Description of the Environmental Setting, and 2) Assessment of Impacts.

Background on Environmental Justice and Applicable Regulations, Policy, and Guidance

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Environmental justice has been part of EPA's mission since the1994 publication of Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.* The Executive Order requires federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities…" It also specifies that environmental justice work include "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions." There is also a special provision for cases where tribal and subsistence resources are affected by an action.

More recently (since 2012), EPA identified three goals in Plan EJ 2014, EPA's strategic plan for addressing environmental justice in the agency's work, to shape work on environmental justice:

- Protect the environment and health in overburdened communities,
- Help communities to take action to improve their health and environment, and
- Establish partnerships with local, state, tribal and federal governments and organizations to achieve healthy and sustainable communities.

Commentors requested this environmental justice analysis during the comment response process on the draft Feasibility Study of the Lower Duwamish Waterway Superfund Cleanup Options (Lower Duwamish Waterway Group October 2010). Many community members, including a tribal representative from a federally recognized tribe, submitted comments requesting that environmental justice concerns be synthesized and discussed in an "environmental justice analysis". EPA Region 10 agreed that an environmental justice analysis would help define the most significant issues of concern and provide a direct route for community input into the decision-making process to improve cleanup outcomes and reduce exposure for the affected populations.

Although no environmental justice analysis guidance document currently exists for Superfund, this analysis was developed using: EPA guidance documents other EJ analyses references and EJ related documents on fish consumption. Guiding principles and techniques were identified in the Council on Environmental Quality (CEQ) guidance, *Environmental Justice Guidance Under the Environmental Policy Act* (1997), and the *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (1998). The EPA *Toolkit for Assessing Potential Allegations of Environmental Injustice* (2001) and the *Interim Guidance in Considering Environmental Justice in the Development of an Action* (2010) were also sources of information that were used to develop this analysis. In considering how EPA's Superfund project could affect or create EJ concerns for those who subsist on or consume fish within the Lower Duwamish Waterway (LDW), this analysis used the National Environmental Justice Advisory Council *Fish Consumption and Environmental Justice Report* (2002) as a source of guidance.

Environmental Setting

Site Background

The Lower Duwamish Waterway (LDW) is an urban estuary with a long history of alteration and industrialization. The LDW was listed on the National Priorities List (NPL) as a Superfund site in 2001. EPA and the Washington Department of Ecology (Ecology) signed an Administrative Order on Consent with the Lower Duwamish Waterway Group (LDWG), consisting of the Port of Seattle, City of Seattle, King County, and The Boeing Company, in 2000. EPA is the lead agency for the cleanup of the contaminated sediments, while Ecology has the lead on controlling sources of contamination to the LDW.

As part of the consent decree, the parties involved agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS). The Remedial Investigation is an investigation of the nature and extent of contamination posed by hazardous substances at the site. The RI was completed in 2010. As an outcome of the RI, five highly polluted areas were selected for early cleanup either prior to or after Superfund listing. Of these five Early Action Areas (EAAs), three have been completed, and two more will be completed by 2014. The rest of the waterway is currently in the cleanup plan decision process to select the alternative for remediation and is the focus of this document. LDWG has developed a Feasibility Study (Feasibility Study 2012) which lists a suite of different cleanup alternatives for the LDW and the relative costs and benefits of each alternative. The four main contaminants of concern for human health include three groups of chemicals whose member all have similar chemical structure: polychlorinated biphenyls (PCBs), dioxins/furans, and carcinogenic polyclic aromatic hydrocarbons (cPAHs), as well as the chemical element arsenic. PCBs are a legacy contaminant, which means that their manufacture and use in the United States is now outlawed, but they were used in the past for a variety of purposes including as an electrical insulator and as a plasticizer in paints and other materials.

They are known for being persistent, for not breaking down easily in the environment, and are broadly distributed throughout the environment. PCBs are bioaccumulative, increasing in concentration at higher levels of the food web. Dioxins/furans and cPAHs are produced during combustion processes (e.g. burning of plastics or garbage, cooking, heating, and engine operation) and many other industrial processes; cPAHs can also be released from creosote-treated wood, driveway sealers, and used motor oil. Arsenic could come from a variety of sources, given the industrial history of the waterway. Emissions from the ASARCO smelter in Tacoma broadly distributed arsenic through Puget Sound. Arsenic is also a naturally occurring element found in the waters, soils, and sediments of the Puget Sound region. All of the above contaminants, PCBs, cPAHs, dioxins/furans, and arsenic are carcinogenic, and all have been found to have non-cancer human health effects as well. In particular, PCBs pose developmental impacts for the developing fetus and children. In addition to human health concerns, forty-one contaminants of concern are present at concentrations toxic to benthic invertebrates.

The Lower Duwamish Waterway: development, history, resources, and culture

Up until the 1850s, the land surrounding the Duwamish River (Figure 1a-c) was occupied by Native Americans and remained forested, but after that time, settlers began clearing surrounding lands. For the Native Americans who live here, the river has served as a transit corridor, spiritual haven, and harvesting and fishing ground. Estuaries such as the Duwamish River served as protected places where native tribes could gather salmon, other fish, and shellfish, as well as plants, berries, and other subsistence resources on a seasonal basis. The flow of the various rivers (the White, Black and Cedar Rivers) that are the source of the Duwamish, Seattle's only river, were modified in the early 1900's for flood control and navigational purposes. These flow modifications as well as dredging and straightening the Duwamish itself to enhance navigability, resulted in monumental changes to the river. Despite these alterations, the Duwamish remains a cultural, commercial, and subsistence resource for tribes in the area.

Currently, the Duwamish River connects the Green River to the south and Puget Sound to the north. The Lower Duwamish Waterway (LDW) Superfund study area extends a little over 5 miles south of the southern tip of the man-made Harbor Island (Figure 1a) to the Norfolk Combined Sewer Overflow (CSO) near the Boeing Developmental Center in Tukwila. Seattle and King County drain approximately 32 square miles into the LDW through point and nonpoint source runoff and combined sewer overflows. The Upper Duwamish and Green River watersheds further drain over 480 square miles into the LDW. As a result of the dredging, straightening, and armoring of the channel in the 19th and early-mid 20th centuries the LDW is highly altered. In total, 9.3 miles of meandering river were replaced by 5.3 miles of straightened channel by 1916 (Battelle 2001). Although peak flows have been much reduced with the upstream flow diversions and dam, sediment loads remain significant. It is estimated that over a typical two year period, maintenance dredging for the channel within the LDW removes over 33,637 to 199,361 cubic yards (roughly 246,000 metric tons) of sediment (RI). Few natural meanders remain along the river, with the exception of Kellogg Island, which, although far reduced in size and character from its original state, serves as productive intertidal habitat for birds and mammals, including eagle and other raptor nesting-sites. Almost all of the original mudflats and tidal marshes from the time of the historical Duwamish estuary have been filled in or dredged, leaving only 59 acres total (mudflats + tidal marshes) remaining (RI; Windward 2010).

Subsequent to the channelization in the early 1900s, the area surrounding the Duwamish River became further developed by a variety of different industries, ranging from wood products manufacturers, to marina and airplane parts manufacturers. Boeing Field and several Boeing Airplane production facilities were established in the 1920s and 30s. Several of these past industries resulted in "legacy" contamination issues in the LDW, such as polychlorinated biphenyls (PCBs).

The waterway is a classic strongly stratified salt-wedge estuary, where fresh water flows over the top of a salt water wedge (Pritchard 1967) with little vertical mixing. The water column is mostly fresh north of river mile 8.7, with salt stratification present throughout the waterway, and the position of the leading edge of the salt wedge dependent upon tidal conditions and river flows. Model-derived budgets have provided estimates that bed sediments deposited throughout the LDW are dominated by Green River-derived sediments (Feasibility Study 2012).

As a dynamic estuary, the waterway is home to a diverse ecology, with abundant anadromous and resident fish, shellfish, other invertebrates, marine mammals, and birds. Recent sampling events yielded a particularly diverse group of crustaceans. The most abundant crustaceans found were crangon and coonstripe shrimp and slender crabs. Dungeness crabs are also common where salinities are higher. Up to 33 species of fish have been found during prior studies. During sampling for the Superfund RI in 2004 - 2007, 17 species of fish were found, including English and rock sole, Pacific herring, and starry flounder and salmonids (including chinook, coho, and chum salmon). The sampling found the most abundant catches in late summer and fall (Windward 2010). Altogether, nine salmonid species are found in the Green and Duwamish rivers. The LDW is also home to 87 species of birds and 6 mammals (Windward 2010).

Affected Area and Populations

The two main mixed residential/commercial Seattle neighborhoods adjacent to the LDW are South Park and Georgetown, and there are other segments of neighborhoods that are within a 1 mile radius of the LDW. The South Park neighborhood, within and adjacent to the southern edge of the Seattle city limit, borders the west bank of the LDW. The Georgetown neighborhood is located east of the LDW and E Marginal Way S. The two neighborhoods foster a diverse and vibrant range of cultures and ethnicities, and they include a large concentration of artists and artist studios. The neighborhoods flanking the LDW, including the South Park and Georgetown neighborhoods, are considered by EPA and Ecology to have potential environmental justice concerns in accordance with Executive Order 12898, *"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"*. There are relatively large low-income populations and/or large minority population in the affected neighborhoods around the LDW, in comparison to Seattle and King County (Census, 2010; Tables 1.1 and 1.2), and the federally recognized Muckleshoot and Suquamish Tribes use the waterway for usual and accustomed fishing rights.

For this analysis, and consistent with previous EPA guidance documents (CEQ 1997; EPA 1998), "minority" refers to people who are identified as Hispanic/Latino, as well as those who are non-Hispanic/Latino of a race other than White or European-American. For the purposes of this analysis, low-income is 1.25X the poverty threshold from the Census thresholds 2011. For households, where the average household size in Seattle is 2.8, 1.25 times the poverty threshold for three people is ~$22,500. As a threshold, and because of the way Census 2010 median household income data is summarized, any household under $25,000 is considered low-income in this analysis.

As Table 1.1 shows, minority populations are significantly larger in South Park than in Georgetown, Seattle and King County. The non-Hispanic Georgetown minority population has decreased since the 2000 Census, and the percentage of non-Hispanic minorities is smaller than that of Seattle's (based upon census tract data), although the Hispanic population remains significantly higher than that of Seattle or King County. The per capita incomes are significantly less in both the Georgetown and South Park census tracts than for Seattle and King County, and similarly, the percentage of households earning less than $25,000 and those in poverty are statistically significantly higher in South Park and Georgetown than in Seattle or King County. It should be noted that demographic changes have occurred throughout King County and South Seattle between the two census data collection efforts, the U.S. Census 2000 and 2010. These trends and the speed of change in LDW area demographics should be kept in mind in planning future activities in these neighborhoods, since the decision, design, and construction will likely take a decade or longer to fully implement.

In Table 1.2, a broader analysis shows that for the total population living within 1 mile of the LDW, the minority population is significantly larger than and incomes are significantly lower than those of Seattle and King County residents on average (Table 1.2).

Demographic Characteristic	[illegible] Census Tract 112	[illegible] Census Tract 109	[illegible]	[illegible] County
[illegible] Population	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Breakout	10.3% Black 1.9% American Indian	7.4% Black 1.9% American Indian	7.9% Black 0.8% American	6.5% Black 1.1% American

	15.8% Asian (0.3% Asian Indian 1.2% Chinese 1.7% Filipino 0.3% Japanese 0.1% Korean 6.9% Vietnamese 5.3% Other Asian) 1.6% Pacific Islander 19.9% Some Other Race 37.3% Hispanic of Total	9.8% Asian (0.1% Asian Indian 4.3% Chinese 1.6% Filipino 0.2% Japanese 0.2% Korean 1.6% Vietnamese 1.9% Other Asian) 0.3% Pacific Islander 6.4% Some other Race 12.3% Hispanic of Total	Indian 13.8% Asian 0.4% Pacific Islander 6.6% Hispanic of total	Indian 15.0% Asian 0.8% Pacific Islander 9.2% Hispanic of total
Income				
% Households with Income < $25,000	27.3%	37.5%	20.4%	18.4%
% Poverty Status in last 12 mos.	16.1%	14.0%	12.7%	10.2%

Table 1.1: Demographic data for South Seattle Neighborhoods of South Park and Georgetown, Seattle, and King County (U.S. Census 2010 and ACS 2005-2009). Poverty status based upon U.S. Census ACS 2010 5-yr computations and average threshold. Differences are statistically significant. Margins of error are found in ACS 2010-5yr average data [add link]

The GIS-based screening assessment compared the characteristics of populations and facility density within one mile of the LDW, with populations located within one mile of the Salmon Bay and Lake Union water bodies (Table 1.2). Salmon Bay and Lake Union, both within Seattle, were chosen for comparison with the LDW because they share a similar history of industrialization along major waterways. Finally, the LDW and Salmon Bay/Lake Union data were contrasted with data extracted from along the I5 corridor. The I5 transect is considered to be representative of Seattle more generally while being compiled using similar GIS-based methods for comparability.

Location	Population	Race	Language	Income/Education	Age	Land Area/ Water Area	All EPA FacilitiesPermitted[4]	TRI Facilities
Seattle I5[1]	Tot: 1,003,516 Dens: 5,111/mi^2 Minority: 33%	White: 71% Black: 7% Amer. Indian: 1% Asian: 14% Pac. Islander: 1% Other: 3% Hispanic of Total Population: 8%	Non-English at home: 23% English less than well: 5%	Per capita: 40,307 25K or less: 19% % 25+ no HS diploma: 8%	0-4: 6% 0-17: 18% 18+: 82% 65+: 12%	196.35 mi^2 46.08 mi^2	Total: 4169 21.2 Facilities/mi^2	Total: 133 <1/ mi^2
Salmon Bay to Gasworks[2]	Tot: 86,573 Dens: 8,530/mi^2 Minority: 19%	White: 83% Black: 2% Amer. Indian: 1% Asian: 9% Pac. Islander: 0% Other: 1% Hispanic of Total Population: 4%	Non-English at home: 12% English less than well: 1%	Per capita: 46,535 25K or less: 16% % 25+ no HS diploma: 2%	0-4: 4% 0-17: 11% 18+: 89% 65+: 8%	10.5 mi^2 2.8 mi^2	1134 108 Facilities/mi^2	24 ~2 Facilities/mi^2
LDW[3]	Tot: 21,864 Dens: 2,525/mi^2 Minority: 52%	White: 59% Black: 8% Amer. Indian: 2% Asian: 18% Pac. Islander: 2% Other: 6% Hispanic of Total Population: 18%	Non-English at home: 36% English less than well: 11%	Per capita: $26,802 25K or less: 20% % 25+ no HS diploma:19%	0-4: 8% 0-17: 21% 18+: 79% 65+: 9%	8.66 mi^2/0.76 mi^2	1601 185 Facilities/mi^2	61 7 Facilities/mi^2

Table 1.2: Demographic and environmental data for three contrasting areas, Seattle I5 Corridor (6 mile radius around the I5); Salmon Bay to Gasworks, Ballard and South Lake Union transect, 1 mile radius; and LDW transect, 1 mile radius.

GIS data from a 6-mile buffer around the centerline of the interstate 5 was also compiled to capture socio-demographic information for the city of Seattle. Data sources included the Census 2010 and the American Community Survey database (data from 2006-2010), together with EPA databases of permitted facilities (Table 1.2). Highlights from this analysis include:

1. per capita incomes are approximately 50% lower in the LDW corridor ($26,802) than near the Salmon Bay to Lake Union ($46,535) and Seattle ($40,307) location;

2. the diversity is much higher in the LDW location, greater than 50% minority, compared to 19 and 33%;

3. the percentages who do not speak English well and who do not possess a high school diploma are much higher in the LDW location than in the other two transects;

4. the total number of facilities (all EPA permitted facilities) and total TRI facilities (large sources only) per square mile is much higher for the LDW transect than the other transects examined. There are 185 total facilities, of which 7 are TRI-reporting (large

source) facilities per square mile for the LDW compared to 108 total with 2 TRI per square mile and 21 total with < 1 TRI-reporting per square mile for the Salmon Bay and Seattle transects, respectively.

Tribal Rights and Presence

The federally-recognized Muckleshoot and Suquamish tribes have fishing rights along the Duwamish Waterway. The treaty rights for tribes along the Duwamish were established in the Treaty of Point Elliott. The fishery catch allowed by tribal treaty rights were further defined in the 1974 Boldt decision[1], which affirmed that 50% of the catch from an area identified as a tribal usual and accustomed fishing and harvesting area should go to tribes with rights for that area as defined in the Treaty of Point Elliott. Usual and accustomed areas for different Tribes often overlap in Washington, as is the case in the Duwamish Waterway. The LDW is primarily a treaty fishing area for the Muckleshoot tribe, which has an active salmon fishery, while the Suquamish tribe manages fisheries north of the Spokane Street Bridge (Figure 1b). The Duwamish tribe (ancestors of Chief Si'ahl or Seattle) has long petitioned for federal recognition, and remains a presence in the region, with a newly-constructed Duwamish Longhouse located along the Duwamish River, and the use of Herring House Park for cultural ceremonies.

Past tribal fish consumption surveys (which included surveys of the Tulalip and Suquamish Tribes) have found that seafood consumption rates are very high among tribal members who have been surveyed in comparison to EPA's National Toxics Rule default rate of 6.5 g fish/day and EPA's recommended water quality national default fish consumption rate of 17.5 g fish/day. Tribal rates from various surveys range up to a maximum of 1,453 grams per day for the Suquamish tribe (as determined by computing the gram per kilogram per day consumption rate by a body weight of 79 kilograms), with the actual rate depending upon the tribe, age (child or adult), and the source, species of shellfish or finfish. The rates also are based on current consumption patterns which are suppressed, and not the unsuppressed consumption rates that would take place with improved access to more/cleaner resident seafood resources.

Tribal access to fish along the LDW is not just a matter of consumption but of culture. See for example the expression of ties to Puget Sound fisheries in the Suquamish Tribe's fish consumption survey (Suquamish Tribe, 2000[2]):

"The Suquamish culture finds its fullest expression in the acknowledged relationship of the people with the land, air, water, and all forms of life found within the natural system. River

[1] *United States v. Washington*, 384 F. Supp. 31 D (W.D. Wash 1974)

[2] Suquamish, 2000. Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region. August 2000. The Suquamish Tribe Fisheries Department, Suquamish, WA.

systems, lakes and numerous small creeks historically supported abundant coho, chinook, sockeye, and chum runs, with other salmonids and marine fish available as well. The same forests which sustained life in the riparian zones also harbored deer, bear, and other wildlife. Vast expanses of intertidal habitat supported shellfish....Despite degraded water quality and habitat, tribal members continue to rely on fish and shellfish as a significant part of their diet. All species of seafood are an integral component of the cultural fabric that weaves people, the water, and the land together in an interdependent linkage which has been experienced and passed on for countless generations."

Non-tribal Fish Consumption Patterns and Rates in the LDW – Available Data

In general, few quantitative data on fish consumption rates are available for non-tribal populations, and the available tribal surveys are generally used as a surrogate representing what exposure might be in the future. Some quantitative data and some more anecdotal data have been gathered in King County, along the Duwamish River, and at the waterway and in local neighborhoods. Sechena et al. (1999)[3] gathered quantitative consumption date from the adult Asian and Pacific Islander (API) community in the Pacific Northwest, and included ten API ethnic groups. Asian Pacific Islanders are a fast-growing immigrant population and comprise people who have origins in Far East Asia, Southeast Asia, the Indian subcontinent, or the Pacific Islands. The researchers found that the respondents consumed seafood at a high rate, with a median of 1.439 grams/kg body weight/day. There was a preference for shellfish (49% of all seafood). First generation APIs consumed more than second generation for all fish categories except pelagic fish (fish that reside in the water column). Out of all the populations surveyed, the Vietnamese and Japanese communities had the highest total fish consumption rates. The pattern of parts of fish consumed varied by ethnic group. Overall, skin was consumed with fillet a majority of the time, and the hepatopancreas of crabs ("crab butter") was often eaten with the meat. Seafood cooking fluids were also often consumed.

An angler survey was conducted in King County and included the LDW (Mayfield et al. 2007[4]). Due to the study design, the fish consumption rates provided in the study should be interpreted with caution, however, it does provide evidence that a diverse group of individuals fish out of the Duwamish and provides some qualitative information on fishing and consumption patterns. Of the 152 Duwamish River respondents, 20% consumed their catch alone and 51% shared their catch with other family members. Other respondents gave away the fish, re-released

[3] Sechena, R. et al. 1999. Asian and Pacific Islander Seafood Consumption Study. EPA 910/R-99-003.

[4] Mayfield, D.B., S. Robinson and J. Simmonds. 2007. Survey of fish consumption patterns of King County (Washington) recreational anglers. Journal of Exposure Analysis and Environmental Epidemiology. 17:604-612.

it, or used it as bait. 80% of respondents were fishing for finfish, 8% for shellfish (mostly crabs), and 12% for both. It should be noted that the part of the Duwamish River that was surveyed was estuarine in nature, and anglers there exclusively caught marine species. The majority of respondents (59%) who ate the finfish caught in the Duwamish River consumed the fish fillet without skin, 29% consumed the fillet with skin, and 12% ate other parts of the fish such as the head or organs. For all marine sites in King County (North King County, Duwamish River, and Elliott Bay, all locations) sampled by Mayfield et al. (2007), ethnic differences in seafood consumption rates were observed. However, because many individuals did not allow their catch to be weighed and other average weights were therefore substituted in order to calculate consumption rates, the seafood consumption rates reported in the Mayfield et al. study likely underestimate the actual seafood consumption rates and are not considered as quantitative and representative of actual rates as the tribal and API studies.

In addition to the above surveys, the Environmental Coalition of South Seattle (ECOSS) conducted a qualitative survey of seafood consumption patterns in November 2010[5], using outreach specialists to survey recent immigrants and others who live in neighborhoods near the LDW. Because many residents had limited English proficiency, they conducted the surveys in multiple languages. The survey questions centered on individuals' fish consumption practices and knowledge of fish contamination issues. The ECOSS findings showed that people fished in the Duwamish for consumption and recreation. It also found that several respondents friends and relatives who fished locally and from roadside stands. Consumption patterns (parts of fish eaten, times of year or rates) differed among interviewees based on cultural and religious characteristics and beliefs. Many responded that having a source of inexpensive fresh fish is important, and others mentioned the importance of having safe places to fish and knowing the health risks involved with fishing. Some respondents asked for more information on the cleanup process and what it means for health and recreation.

Part II: Assessment of Impacts

This Section will cover:

1) the assessment methodology
2) an overview of health status and vulnerability identified through available data,
3) potential cumulative exposures and risks along the LDW
4) the impacts of this decision on affected populations and mitigations for disproportionate adverse impacts, where found

[5] ECOSS report to EnviroIssues, 1/31/11: letter subject: Lower Duwamish Waterway Outreach Summary

Methodology

LDW Remedial Alternatives

The Superfund LDW proposed remedial alternatives comprise 6 different cleanup scenarios and additional variations. These range from a "no action" alternative, where no additional measures are taken to clean up the waterway beyond the early action cleanups that have already taken place or have been planned, to option 6R, which is the alternative with the largest remedial footprint and the most sediment removal and disposal of all of the options. Several figures in the Feasibility Study (2012) describe the remedial alternatives in great detail, including the footprints for each alternative, and the remedial actions that would take place throughout the waterway, ranging from natural recovery, to enhanced natural recovery, to sediment capping, to sediment dredging and removal. The potential for the different alternatives to disproportionately and adversely impact people affected by the site are examined in this part of the EJ Analysis.

Health Concerns and Impacts Evaluated in the Risk Assessment

In the LDW Superfund Cleanup Human Health Risk Assessment (HHRA; 2007) several possible routes of exposure for excess cancer and non-cancer risks associated with the site were identified. The exposure route with the greatest cancer and non-cancer risks was through eating contaminated resident (majority of life cycle spent in the LDW) seafood from the LDW. The risks were evaluated for consumption rates identified as tribal adult consumption rates, tribal child consumption rates, asian and pacific islander consumption rates, and a one meal per month consumption rate[6]. The consumption rates and years of exposure for consumption were derived from EPA (2007[7]) and the Sechena et al. Asian and Pacific Islander Consumption Rate Study as reinterpreted for risk assessment purposes by Kissinger (2005)[8]. In addition to seafood consumption, direct contact with sediments was determined to be of potential risk and evaluated in the human health risk assessment.

Environmental Justice Concerns from the Affected Community

In comments on the Draft Feasibility Study (2010), some community members have expressed concern for the multiple exposures present near the site, due to the concentration of facilities and mobile sources in the vicinity, and the relative vulnerability of the populations in the area. Some community members and tribal comments emphasized the need to protect the most vulnerable populations exposed to the contamination in the waterway. Tribal comments also asserted that for any remaining contamination that may be left in the waterway under caps

[6] One meal per month is not a realistic seafood consumption rates for affected populations and is presented only for seafood consumers to be able to calculate their individual risks

[7] Add shellfish framework citation

[8] Kissinger L. 2005. Application of data from an Asian and Pacific Islander (API) seafood consumption study to derive fish and shellfish consumption rates for risk assessment. Office of Environmental Assessment, US Environmental Protection Agency Region 10, Seattle, WA.

or other engineered devices, the methods used should ensure no recontamination of the waters and fish tissue and not inhibit tribal rights in the LDW. Industries located in the LDW have expressed concern over the costs of cleanup and impacts to jobs and the economy locally. [insert findings from HIA work]

Identifying Disproportionate Adverse Impacts and Mitigations

Previous work, studies, and data sets were reviewed to identify cumulative impacts and disproportionate and adverse impacts at the site, in comparison to elsewhere in Seattle and King County (where adequate comparative data were available). These data represent our current understanding of environmental burdens and the distribution of environmental benefits in the LDW. From this set of data, the impacts identified will then be evaluated in light of the decision in hand, for each of the alternatives to the maximum degree practicable, and appropriate mitigations are suggested for any adverse disproportionate impacts that are found. An impact will be considered adverse and disproportionate when some populations are more exposed to risk or adverse effects, and unacceptably so (risks are above federal and state standards or will significantly impact day to day life) than others and the decision in hand will not fully alleviate that risk or effect such that it is within the federal and state standards for acceptable risk or will disrupt cultural or economic resources and daily life. A moderate adverse impact is when the risks calculated using affected population-based health status and exposures to be within the acceptable risk for exposure, however, the known health outcomes linked to the route of exposure are adverse and disproportionate for the affected populations, or the effects on the cultural or economic resources and daily life, and mitigations are still warranted to avoid any additional excess risk to vulnerable populations.

Current understanding of vulnerabilities, exposures and risks along the LDW

Site-specific local data is required to better define cumulative environmental burdens, social vulnerabilities, and environmental justice concerns within LDW communities. There are many sources of local data available for establishing an understanding of current health status, vulnerability to chronic disease, environmental burden, and underlying socioeconomic factors which may exacerbate the impacts of a particular decision on the affected community. These factors present a picture of current conditions, health status, and environmental burdens that can be useful in determining environmental impacts and outcomes for populations affected by the Superfund cleanup. In particular, community attributes, including environmental attributes, contribute to health status. Examples of environmental features that contribute to the health status of a population, include: food deserts[9], the presence of greenspace, parks, and bike lanes, and the presence of brownfields site

[99] As defined by the Healthy Food Financing Initiative, a partnership of between the Treasury Department, Health and Human Services, and the Agriculture Department, as a "low-income census tract where a substantial number or share of residents has low access to a supermarket or large grocery store". Low-income is defined as 1) a poverty rate of 20 percent or higher, OR 2) a median income at or below 80% of the area's median family income, and "low-access" is defined as a community of at least 500 people and/or at least 33 percent of the census tract's

[10] and pollution sources.

Health Status of Affected Populations

Epidemiological data on the health status of a community can provide information on the vulnerability of a community to environmental contamination, and many disease incidence rates are associated with exposure to environmental contaminants. Several studies have examined health disparities around King County, and some disparities have been shown in King County's most recently summarized health statistics from 2009[11] (based upon 2003-2007 data). The King County health planning areas (HPAs, geographic areas with populations that are sufficiently large enough to provide statistically significant data for comparison) consolidate neighborhood data together for the Duwamish region. The South Park and Georgetown neighborhoods are within the Beacon Hill planning area (Beacon HPA). In the most recent set of data, South Seattle and the Beacon Hill Planning area have higher rates of some chronic illnesses and worse outcomes for life expectancy, infant mortality, and some well being indicators than many other HPAs in Seattle. Life expectancy in the Beacon HPA is 79.5 years on average. This is 1.5 years less than the King County average, and 3.7, 4.7, and 5.8 years lower than the average life expectancies for Queen Anne, Ballard, and Northeast Seattle HPAs, respectively. This life expectancy is also significantly different from the King County average of 81.0 years. An additional analysis by Public Health Seattle and King County has compared the trend in life expectancies by census tract for King County to the trend in life expectancies found for the ten longest lived countries, "ten-countries". Although there were too little data to do the comparison between Georgetown and the "ten-countries" dataset, for the South Park census tract, life expectancy is stuck approximately 24 to 57 calendar years behind that of the "ten-countries" life expectancy trend[12].

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population must reside more than one mile from a supermarket or large grocery store (for rural tracts, the distance is more than 10 miles).

[10] The term brownfields site means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

[11](http://www.kingcounty.gov/healthservices/health/data/chi2009/HealthOutcomesLifeExpBirth/HPA.aspx)

[12] 2005-2009 data – As presented by D. Fleming: *Health of King County Focus: Health Inequities*. http://www.kingcounty.gov/healthservices/health/healthofficer/~/media/health/publichealth/documents/data/HealthofKingCounty2012.ashx, accessed October 18, 2012. Example – an outcome of 81.8 years for the 10 countries' life expectancy in 2009, when U.S. life expectancy was only 78.2 years, means that U.S. life expectancy is the same now as the 10 countries were 16 years ago.

Beacon childhood asthma hospitalization rate is 306 per 100,000 individuals under the age of 18, and, at over twice the rate of King County's is the highest rate of all HPAs. The Beacon HPA infant mortality rate is +1.4 deaths per 1,000 live births higher than the rate for King County, and 2.0 deaths per 1,000 live births greater than that of the Ballard and Northeast Seattle HPAs (Queen Anne had too few deaths to be statistically significant). The

There are also differential asthma rates within the Seattle area. Asthma rates within Seattle city limits are statistically significantly higher than other areas of King County in general (Figure 2). The Beacon childhood asthma hospitalization rate is 306 per 100,000 individuals under the age of 18, and, at over twice the rate of the average within King County is the highest rate of all HPAs. The adult asthma hospitalization rate from 2003-2007 was almost twice as high in Beacon HPA as in King County on average, and it is approximately 10% higher in the neighboring Delridge/West Seattle HPA than on the King County average (all rates are statistically significantly different). Delridge and Beacon Hill populations are neighborhoods that, though not immediately adjacent to the LDW, are potentially affected by sources of air pollution.

Other chronic diseases are significantly higher in the Beacon HPA, including the rate of death by stroke, and diabetes rates, on average, compared to King County as a whole. 14.6% and 14.2% of the Beacon HPA and West Delridge HPA populations, respectively, are characterized by "Poor or Ill Health" according to the King County Indicators, in comparison to 10.5% of the population for King County on average, and 6.7% and 8.8% for Queen Anne and Ballard, respectively.

A more recent analysis based upon U.S. Census tract (2005-2009 U.S. Census Bureau) and WA State Dept. of Health Center for Statistics data for the Duwamish Valley (DV) as a whole (Appendix 1), which includes South Park and Georgetown and other South-Central Seattle neighborhoods, similarly revealed significant differences between the socioeconomic and health characteristics of the DV area and King County (KC)[13]. For example:

- the average poverty level for the DV (17.6% v. 9.7% for KC);
- 31.9% of the DV is foreign born v. 19.0% for KC;
- 20.1% of the DV lack a high school degree v. 8.2% for KC;
- 75.4% lack a bachelor's degree v. 55.2% for KC;
- the DV also has a relatively high homicide rate at 10.5 per 100,000 individuals.
- life expectancy in the DV is lower than in KC (79.4 v. 81.3 years for KC);
- lung cancer and asthma hospitalization rates for children and adults were higher for the DV compared to KC (2005-2009 WA Dept. of Health data). Asthma hospitalization rates are 67% higher for children and 60% higher for adults in the DV than for KC.

[13] In this case, for statistical reasons, health data were aggregated for the Duwamish Valley, instead of individual tracts for South Park and Georgetown, and census data were similarly aggregated to enable a direct comparison.

Public Health Seattle & King County also has created an independent social vulnerability index particular to Seattle, which uses factors including the health status of the population. In the most recent King County/City of Seattle social vulnerability index, the Georgetown and South Park neighborhoods ranked medium to high risk (Seattle Hazard Identification and Vulnerability Analysis, City of Seattle May 14, 2010[14]:). Within King County, racial and ethnic disparities exist for several health indicators. Because there is higher diversity in South Seattle within the neighborhoods within a 1 mile radius of the LDW, these disparities are important to consider. Obesity prevalence, mortality rates due to stroke, and diabetes rates, for example, are much higher for African Americans, American Indians, and Hispanics/Latinos, than for Whites or Asian/Pacific Islanders, as defined in the 2010 Washington State Department of Health Behavioral Risk Factors Surveillance System. For example, based upon 2006-2010 data, the obesity prevalence for African Americans and American Indians were 68%, 66% for Hispanics/Latinos, 56% for Whites, and 37% for Asians/Pacific Islanders. Adult rates of asthma are much higher for American Indians than for any other race or ethnicity surveyed[15].

Cumulative Exposures and Access to Environmental Benefits

Several indicators of the burden of pollution in the Georgetown and South Park neighborhoods are stronger than in surrounding neighborhoods in Seattle, and King County. The South Park and Georgetown neighborhoods are a mix of industrial and residential uses, and the neighborhoods are located near hubs for transportation, including major roadways (Highways 99 and 5), rail spurs, and the Port of Seattle (Figure 1c), including the King County Airport, Boeing Field flight-paths, and on the flight-paths from the Seattle-Tacoma International Airport.

Proximity to Pollution

Hazardous Waste and Facility Density

Hazardous waste facilities and other pollution point sources in the City of Seattle tend to be more concentrated along industrial corridors including the Duwamish Valley and around the LDW. The facilities also correlate with low income and areas with large minority populations (Figure 3; King County). From King County's "Communities Count" website[16]: "[Between 2003 and 2007] the percent of people living near hazardous waste storage treatment and disposal

[14] http://www.seattle.gov/emergency/publications/documents/SHIVA.pdf
[15] Accessed from www.kingcounty.gov/healthservices/health/data/chi2009.aspx on Oct. 18, 2012.
[16](http://www.kingcounty.gov/healthservices/health/data/chi2009/HealthOutcomesLifeExpBirth/

facilities increased for people living in areas with incomes below the County median household income and for those living in areas with racial diversity greater than the County average." EPA maintains a Toxics Release Inventory Database that tracks self reporting facilities that store or use hazardous substances. In the city of Seattle, the majority of these facilities are concentrated along the Duwamish waterway (Figure 10).

In a recent paper, Abel and White (2011) reported on a retrospective analysis for Seattle that examined the change in TRI-reporting air emitters and the risk from those emitters using EPA's RSEI (Risk-Screening Environmental Indicators tool). They computed a "gentrification index" from 1990-2007 which included factors related to racial and ethnic diversity and income based upon census block group data. From this index, the neighborhoods in South Central Seattle, including South Park and Georgetown, were among the few clusters of block groups in Seattle to incur a disproportionate burden from air pollution sourced from large industrial emitters while demonstrating few changes in race and income over the time period of study. The trends indicate that the total burden from large industrial air pollution sources and location of new industrial sources are of particular concern for South Central Seattle, and they are not evenly distributed throughout Seattle. This is of concern because it indicates an additional risk that may be placed on low income and minority communities. Note that there are caveats in using RSEI to infer direct risk from individual emitters and mobile sources of air emissions are not included in the tool.

Community groups have raised concerns over gentrification as a negative outcome for a successful Superfund cleanup within the LDW. The community groups envision revitalization rather than gentrification of the neighborhoods surrounding the LDW to preserve the benefits of their diverse and vibrant communities

Air

Recent studies have raised concerns about the impact of mobile sources of air pollution, which are sources such as trucks and cars that are not fixed in one spot, together with fixed sources of air pollution, on the health of the South Park and Georgetown neighborhoods. These studies have included monitoring, GIS-based, and numerical modeling-based research. For example, the concentration of moveable-goods facilities, which serves as an indicator of mobile sources of air pollution, are clustered along the LDW when compared with the rest of Seattle (Figure 4). In addition, due to community concerns about air, the Washington Department of Health conducted a regional modeling and health risk assessment for the Georgetown and South Park neighborhoods (WA DOH 2008). The numerical modeling and monitoring results of that study revealed that cancer risks from point source emissions held particular concern for two areas in the Georgetown neighborhood and South Park. The 2008 WA DOH study also found that woodstoves present a risk in winter months. Non-cancer health risks from point, fixed

HPA.aspx)

sources were found to be below levels of concern according to the 2008 study.

The neighborhoods of South Park and Georgetown are located adjacent to several major highways, and thus bear high exposure from on-road sources. The modeled on-road mobile sources from the 2008 WA DOH study found that cancer and non-cancer risks were highest near major highways, including highways 99 and 5. The study found that diesel particulates contributed 74% of the excess cancer risk, while benzene contributed 15% of the excess cancer risk, and 1,3 butadiene contributed 9% of the total excess cancer risk. The researchers discussed particular concern for childcare facilities and schools within 500 feet of a major highway (children are more vulnerable for asthma and other air exposure-related health conditions). At the time of the study, there were 13 childcare facilities and 3 schools located within 500 ft of a major roadway in South Park and Georgetown.

In 2010, DOH investigated emissions from a South Park cement plant and assessed monitoring data for trends that could lead to upper-respiratory irritation and difficulty breathing. In the course of the investigation, they found that at the Georgetown monitoring station concentrations of nitrogen oxides were significantly higher than at the neighboring Beacon Hill monitoring site. While the higher concentrations of nitrogen oxide were primarily attributed to vehicle traffic, other sources of nitrogen oxide emissions could have contributed to the high concentrations.

Additional air monitoring data were collected by the U.S. EPA Region 10's Office of Air Waste and Toxics at Concord Elementary School, in South Park during 2009 (U.S. EPA, 2011). The 2009 EPA study revealed that the major constituents of concern that were modeled in the previous DOH studies, including hexavalent chromium, benzene, 1,3-butadiene, and lead, were below EPA levels of concern at the school. However patterns in the data EPA analyzed suggested the strong influence of mobile sources on air quality in the area. A modeling and monitoring evaluation of air quality was also conducted by the Puget Sound Clean Air Agency (2010). The 2010 PSCAA study revealed that in the Duwamish area of Seattle, the excess cancer risk calculated from the nine monitored chemicals which contribute the most to health risk (Carbon tetrachloride, benzene, 1,2-Butadiene, formaldehyde, naphthalene, acetaldehyde, chloroform, and tetrachloroethelene) resulted in a little more than 100 excess cancers per million individuals. This risk is 20% less than the risk calculated for Seattle's Beacon Hill monitoring station, and slightly less than the risk estimated for Tacoma's South L Street sampling location. The potential risks contributed from diesel particulates based on modeled results, however, were found to amount to almost 300 excess cancers per million individuals at the Duwamish site, around 20% higher risk than at Seattle's Beacon Hill site, and almost three times higher than at the Tacoma South L Street site. Overall, mobile sources were found to contribute to over 72% of the excess cancer risk at the Duwamish site. Because all three sites, Tacoma's South L Street Station, Seattle's Beacon Hill site, and the Duwamish location are generally speaking low-income and diverse areas, the data are presented here for informational purposes but only a comparison between the Duwamish location and the average Seattle or King County location would be used to determine whether an existing condition is disparate for the LDW.

The trends seen in the recently-released 2005 review for the National Air Toxics Assessment (NATA) (2011) corroborates the findings of the previously described studies. For census tracts located in the Georgetown and South Park neighborhoods, non-cancer risks fell in the 60-80th and 80-100th percentile categories, nationally. While non-cancer respiratory risks were uniformly high throughout the wider Seattle area, non-cancer neurological risks were highest in central and south central Seattle compared to the rest of the city (Figure 5B), with the exception of some neighborhoods adjacent to Interstate 5. Non-cancer neurological risks adjacent to Interstate 5 (along the I5 corridor) were comparable to south central Seattle rates. Estimated excess cancer risks are also high, between 75 and greater than 100 excess cancers per million individuals, and a pattern of relatively high excess cancer risks again tracked along the Interstate 5 corridor (Figure 5A). The highest estimates of excess cancer risk for census tracts were found in Seattle's Central District.

The NATA data indicates that arsenic concentrations in Georgetown ranked in the 80-100th percentile, and for South Park, 60-80th; for benzene and diesel particulates, similarly 80-100th percentiles, formaldehyde and lead, 60-100th percentiles, and for diesel particulate matter (PM), 80-100th percentiles. The Duwamish area is a former non-attainment area for PM_{10} (solid and droplets of particulate matter of 10 microns or less in diameter), and currently in maintenance for PM_{10}, ground-level ozone and carbon monoxide[17]. In order to become a maintenance area, an area formerly in non-attainment must meet air quality standards and have a ten year plan for maintaining air quality.

Soil

Contamination of soils from present and past industry is also a concern in South Park and Georgetown. In 2010, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the WA Department of Health reviewed dioxin and PCB contamination data in South Park soils[18], and found that measured concentrations were below

[17] WA Dept. Ecology: http://www.ecy.wa.gov/programs/air/other/namaps/Web_Map_Intro.htm

[18] Evaluation of Contaminants in Adjacent Streets and Residential Soils in the South Park Site, South Seattle, King County, Washington. 2010. Health Consultation. WA Dept. of Health. July 28, 2010.

levels of concern for non-cancer and cancer health risks for average exposure assumptions. In discrete samples in South Park in 2008, dioxin concentrations of 90 parts per trillion TEQ (toxicity equivalent, a measure of how toxic a contaminant is by relating the various dioxin types to the toxicity of the most toxic form) were found in roadway soils, and other soil samples tested positive for dioxin in the vicinity (City of Seattle 2008). This exceeded the state standard for unrestricted land use, which is 11 parts per trillion TEQ for dioxin under the WA Model Toxics Control Act (MTCA) program. In 2011 Ecology measured soil dioxin and PAH concentrations in neighborhoods around Seattle. In five of six of those Seattle neighborhoods sampled, which included South Park and Georgetown, the average dioxin concentration in soils was higher than the state MTCA standard but less than the EPA draft cleanup level (72 pptr TEQ). The highest measured dioxin sample concentration, 114.7 pptr TEQ, was found in Georgetown, which also had the highest average concentration, 36 pptr TEQ. The formerly industrialized neighborhood of Ballard had the next highest average concentration, (26 pptr TEQ) while South Park's sample fell in the mid to low average of the six sites sampled (15 pptr TEQ). However, the measured dioxin concentrations minima and maximum were similar for all neighborhoods where sampling took place. Soil dioxin remediation is part of the activities slated for the Terminal 117 Early Action Area cleanup under the Superfund Program.

Another set of contaminants, cPAHs, were measured at the same time during Ecology's 2011 study. The average concentrations for four neighborhoods were above the MTCA screening level (137 ppb TEQ), and included Georgetown soil samples. In addition, soils from all six neighborhoods exceeded the EPA screening levels of 15 ppb TEQ for cPAHs.

Consumption Risks from Resident Seafood Caught in the LDW

The human health risk assessment (HHRA) conducted for the LDW used a range of seafood consumption rates that correspond to a variety of consumption practices by Duwamish community members and local fishers. The information used in the HHRA was derived from EPA's 2007 Tribal Fish and Shellfish Consumption Framework for Puget Sound[19], and the aforementioned Asian Pacific Islander Fish Consumption Study (Sechena et al. 1999). The seafood consumption rates for Tulalip tribal members (RME of 97.5 g/day, comprising pelagic and benthic fish of 15.6 g/day and shellfish of 81.9 g/day, and excluding anadromous fish) were used as the adult tribal scenario, tribal children consumption rates were also based on Tulalip data (RME of 39.03 g/day from all seafood sources, with 6.2 g/day for pelagic and benthic fish, and 32.83 g/day for shellfish). The Asian and Pacific Islanders' (API) consumption rates were

[19] Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia. EPA, August 2007.

taken from the Sechena et al. collaborative study as reinterpreted for the risk assessment by Kissinger (2005) (RME of 51.5 g/day for all sources, and 7.3 g/day for resident species of benthic and pelagic fish and 44.2 g/day of shellfish, respectively). The tribal and API data were used as the reasonable maximum exposure (RME) rates in the HHRA. For comparison, the HHRA also used fish consumption rates of an adult one-meal-per month consumption rate (7.5 g/day), and rates for Suquamish tribal members (an adult tribal scenario based on a Suquamish tribal survey, 583.5 g/day, with 438.6 g/day comprising clams alone, 85.1 g/day benthic and pelagic fish, and 59.8 g/day for crab and mussels).

Although Suquamish tribal members have fishing rights in the Duwamish River, their total fish consumption rate is dominated by shellfish consumption. However, currently the LDW does not support widespread high quality intertidal shellfisheries (HHRA 2007). Therefore, the risk assessors used Tulalip rates rather than Suquamish rates as the median in the HHRA, as they determined that the consumption of fish staples by the Tulalip are more analogous to those found in the LDW. The Suquamish Tribe has raised issue with the use of the Tulalip Tribes' rates as the RME scenario. In addition, tribes (Muckleshoot and Suquamish) have raised the issue that their current consumption rates as recorded in the 2007 framework and in other fish consumption studies (i.e., Suquamish 2000) are suppressed, and that with a cleaner river in the future to support safer and robust fisheries, rates would actually be much higher.

Human health risks for tribal adults and Asian American Pacific Islanders for fish consumption exceed the MTCA WA State standards for PCBs, dioxins/furans, arsenic, and cPAHs, and other contaminants of concern (1 cancer per 100,000 persons, or $1X10^{-5}$ for multiple chemical risks and an individual chemical risk of $1X10^{-6}$). This human health risk for fish consumption was based on the 95% UCL. Essentially, any individual who has to use the LDW as a fisheries resource suffers more health risks than individuals with access to less contaminated resources. Particularly for the tribal and subsistence fishers and others who consume seafood at a higher rate than the general population (consuming at rates closer to EPA's defaults of 17.5 g seafood/day), risks from eating contaminated seafood would be even higher, representing a significant environmental justice concern: an existing pre-cleanup adverse disproportionate impact for these groups of individuals.

Hazards from consuming fish from the LDW were also evaluated by DOH coordinating with ATSDR in 2004 and 2005 (WADOH 2005[20]). The study found that those who consume large amounts of resident fish (which does not include anadromous fish like salmon) caught in the LDW were at some risk for adverse health effects, and that consumption of resident fish

[20] 2005. Lower Duwamish Waterway Site: Updated Fish Consumption Advisory and Evaluation of Marine Tissue Collected from the Lower Duwamish Waterway in August and September 7, 2005. Seattle, Washington. Health Consultation. WA Dept. of Health.

represents a public health hazard. Salmon, which spend a limited amount of time in the LDW, are not included in any fish advisory. The evaluation found that the effects of mercury and PCBs were of greatest concern, due to impacts on the development of children after fetal exposure. The evaluation found that bottom fish like flounder and English sole were of most concern of the fish stocks. There was measurable, although slight, concern raised over the consumption of fish like striped perch. Consumption of red rock and Dungeness crab were also of concern due to high concentrations of PCBs, mercury, and arsenic. Because the concentration of contaminants varies within an organism, the evaluation identified which portions of target species posed the greatest health concern. Fish livers and the crab hepatopancreas (crab butter) concentrate toxins and should be avoided. Based on the findings of the evaluation, the Washington State Department of Health (WA DOH) advisory has been set that advocates that fishers "Do Not Eat" the following resident fish and shellfish: perch, flounder, English sole, crabs, and other shellfish. Some community concerns that were heard during the investigation related to the safety of consuming salmon, the safety of consuming fish at markets, and the lack of adequate warning about consuming seafood from the Duwamish, which are important points to consider in the development of education tools during the Superfund cleanup in the LDW.

Background fish tissue contaminant concentrations around Puget Sound are compiled in the FS 2012, Appendix B, which details non-urban background levels and risks associated with eating seafood in locations outside of urban centers. The risk inter-comparison between the LDW and non-urban contaminant concentrations in seafood tissue shows that adult tribal combined seafood consumption risks for Puget Sound seafood (non-urban) total PCB excess cancer risks are roughly three orders of magnitude less when computed at background concentrations than in the LDW. For the child tribal scenario the total PCB excess cancer risk from seafood consumption is close to two orders of magnitude less for the background scenarios than for the LDW scenarios. For API adults, excess cancer risk levels were also roughly more than two orders of magnitude less for the background scenarios than the risks calculated from the LDW scenarios. For arsenic, the excess cancer risks are moderately lower for Puget Sound seafood compared to the LDW scenarios. Clams are the seafood that contributes more than 97% of the cancer risk from arsenic. Excess cancer risks from tribal adults are approximately an order of magnitude less for non-urban Puget Sound locations than in the LDW. For child tribal and adult API scenarios, the excess cancer risk from arsenic is approximately 75% less for Puget Sound than for the LDW. The hazard quotients, a measure of short term, non-cancer risks, were all less than 1 for adult tribal and API scenarios for the non-urban Puget Sound PCBs and arsenic concentrations, meaning that conservatively no non-cancer risks would be seen from eating fish from non-urban sites. For child tribal scenarios, only the maximum concentration estimates resulted in HQs slightly above 1, 2 for PCBs and 3 for inorganic arsenic. In contrast, for all consumers, HQs were greater than 1 for the LDW scenarios, 24, 52, and 18 for the adult tribal, child tribal and API scenarios for PCBs, and 2, 5, and 2 for adult tribal, child tribal and API scenarios for arsenic, respectively.

Risks from Direct Contact with Sediments or Water

DOH (WA DOH 2005) determined that direct contact with sediments and swimming in Duwamish waters did not represent a public health hazard. The risks from direct contact with sediments, "beach play", were evaluated in the HHRA (2007). Cancer risks for all human health risk drivers combined during the FS 2012 data collection effort, ranged from 4 in 1,000,000 ($4X10^{-6}$) to 6 in 10,000 ($6X10^{-4}$) for the eight individual beaches surveyed. Area 4 was found to have the greatest excess cancer risk. For noncancer risks, the HHRA had calculated that the HQs for beach play did not exceed one for any of the 8 beaches. However, when more data were collected for the FS 2012, higher concentrations were found for one area, Area 4. At the beach in Area 4 (River Mile 2.2W), total PCB concentrations were very high in two samples, which resulted in HQs that were high as well, with a maximum of 187. Otherwise, samples at the beach in Area 4 had HQs of 2, higher than other beaches but less than at the inlet.

LDWG conducted additional sampling at the Duwamish Waterway Park in South Park, which is heavily used by residents. The excess cancer risk from sampling of the park was 2 cancers in 1,000,000 ($2X10^{-6}$), on the lower end of the range of excess cancer risks compared to other beach play areas studied.

Although DOH does not have a public health advisory in place for contact with the site sediments, it has issued a public health advisory to avoid swimming near combined sewer outfalls (CSOs) in the LDW and elsewhere, due to the potential for contact with enteric pathogen (bacteria and viruses) contamination. There are a number of CSOs located along the LDW (Figure 5) in comparison to other neighborhoods around Seattle. CSOs play an important role when rain water overwhelms stormwater drains and reduces flooding higher in the watershed. However, this flood reduction comes at a cost, when these episodes result in bursts of combined sewerage which drains to the LDW. Lateral loading from CSOs, other nonpoint runoff of contaminants, and upstream loading from the watershed for the Lower Duwamish all add to a melange of contaminants that adds to high background sediment concentrations from past and current industry local to the watershed. The LDW is listed as a 303D contaminated waterbody, while serving as a major migration route for Endangered Species Act (ESA)-listed salmonids including chinook salmon.

Access to Environmental Benefits

Greenspace and Food Access

Seattle, also called the Emerald City, is known as a green city. There are over 4 million trees in Seattle, with the most in residential areas. That amounts to approximately 7 trees per person, in contrast to other urban cities such as Los Angeles, which has 6 million trees, total, but approximately 1.5 trees per person[21]. Trees are most numerous in residential areas and natural and developed parks, and they are least numerous in the downtown corridor, commercial/mixed use, and industrial areas. Likewise, in the industrialized and mixed-used neighborhoods surrounding the LDW, greenspace is relatively scarce (Figure 6a and b). Major roadways must be crossed under or over to reach anything but one large park with playing fields in either the Georgetown or South Park neighborhood, unlike the multi-park access that much of Seattle enjoys (Figure 6c). In Georgetown, one playground and one field (sandwiched next to interstate 5, bordered by train tracks and under the flight path for nearby Boeing Field) are the only recreational areas (Figure 6b). South Park (Figure 6a) has relatively more greenspace than Georgetown, comprising the South Park Community Center grounds, the Duwamish Waterway Park and beach, and some other small pocket parks along the Duwamish River. A relatively new bike trail (Duwamish Bikeway) winds along a small part of the western bank of the Duwamish River, and provides recreation linked to the Duwamish, but there is no such path along the eastern bank near Georgetown. South Park's greenspace includes the 4-acre Marra Farm, a working farm and community resource, and an important source of produce for local schoolchildren and residents in an area where no large grocery stores are present.

South Park and the south end of Georgetown are known as USDA-ranked "food deserts" for the lack of easily accessible grocery stores[22]. In combination with obesity statistics and disparities for King County, and with the high diabetes rates for African Americans and Native Americans who live here, lack of access to healthy foods is a significant health issue. Those who fish for and consume Duwamish resident seafood are limited in the choices they can make for acquiring healthy foods from other sources.

<u>Community Assets</u>

Statistics of course do not provide a full view of life in the community surrounding the LDW Superfund site, and many of the impacts above belie strong communities that are working together in an unprecedented way toward achieving environmental justice in their neighborhoods. Many issues raised here are related to historical development of the city, infrastructure, timing, and policies that took place over a long period of time. Therefore, they will take time to resolve and will require that communities, industry, businesses, and multiple agencies move forward together to acknowledge and address the underlying causes and solutions for the disparities and concerns.

The Georgetown and South Park communities each have strong community neighborhood associations (South Park Neighborhood Association and Georgetown Community Council) which are actively tackling issues that face their communities together with the City of Seattle and King County. For Georgetown, a Georgetown Neighborhood Plan was created in the community in the late 1990's, and additionally, the community has done visioning for the future

[21] *Seattle's Forest Ecosystem Values.* Green Cities Research Alliance, August 2012. Report located at: www.itreetools.org/resources/reports.php
[22] http://www.ers.usda.gov/data/fooddesert/fooddesert.html

of Airport Way and the Duwamish River. This work has resulted in the development of Oxbow Park, neighborhood P-Patches, and better community space in the neighborhood. The community has also worked together to save historical public art, the "Hat 'N' Boots" icons from the 1950s that are now located at Oxbow Park. South Park has created the "South Park Action Agenda" which targets five areas for improvement, including,

- Environmental and physical
- Business and transportation
- Community engagement
- Youth development, and
- Public safety.

Both neighborhoods are cohesive and many activities involve neighbors helping neighbors. The community activities bridge diverse cultures, languages, and socioeconomic barriers. For example, Marra Farm, an icon in South Park, supplies organic produce to neighboring schools and is a source of outdoor recreation, food, and environmental education in the area. South Park Arts, is an organization that works to bring art to the South Park neighborhood and hosts monthly events. Recently, the group developed a neighborhood-wide mini-golf course, with South Park-inspired mini-golf holes throughout the neighborhood.

The seventeen-member South Park Citizens Advisory Group formed in 2002 to provide community input on the new South Park Bridge that is scheduled to be finished in 2013, and the group gave suggestions on the design which changed the design chosen, retained the artistry of the original landmark bridge, and reduced impacts on local neighborhoods. Community artwork and art venues along with historical buildings figure prominently in South Park and Georgetown, and around the LDW, including the Duwamish Tribe's Longhouse and Cultural Center and Art Gallery and exhibit area, the new fish schooner sculpture at Terminal-107 Park that was just finished along the Duwamish trail on land owned by the Port of Seattle, and the historic Old City Hall and original Rainier Brewery (now the Georgetown Brewhouse).

The neighborhoods flanking the LDW also have a resource – the LDW, Seattle's only river, and environmental and economic benefits from that river. The annual Duwamish River Festival includes music, cultural, and river-based activities to South Park and LDW. South Park Cinco de Mayo, Fiestas Patrias, and Dia de los Muertos events happen annually. Youth Development programs such as "Project Wild" (video here: http://www.youtube.com/watch?v=iKH6wgRcutk), for example, have enabled youth from diverse communities around the LDW to interview and learn from those who use the river for fishing about why they fish, how they fish, and the importance of the river to them. Another source of community involvement around the environment is the "Green Jobs" program at Georgetown Community College (funded in part by a grant from the U.S. EPA), which serves as a resource for communities surrounding the LDW to learn how to be involved in action for the future of the environment they live in.

Evaluation of Impacts from this Decision on Minority and Low-Income Populations including Tribes and Tribal Resources

Impacts Considered for Suite of Remedial Alternatives

In its Superfund Feasibility Study (AECOM, 2012), the Lower Duwamish Waterway Group presented a range of remedial alternatives for reducing risk to human health and ecological targets (benthic invertebrates and river otter). The published alternatives ranged from "Alternative 1" - no further cleanup after completing cleanup of the early action areas, to Alternative 6R which requires a large area of the waterway to be dredged. In between these endpoint alternatives, the other variant alternatives included 2R, 2R-CAD, 3C/3R, 4C/4R, 5C/5R, and 6C. They represent a range of dredging, capping, enhanced natural recovery (stabilization of sediments with a thin cap of clean sediment), and monitored natural recovery (monitoring of sediment contaminant concentrations to ensure that "cleaner" sediments from upstream are gradually emplaced naturally over currently contaminated sediments) (Figure 7).

Factors Considered

The hallmark of the Superfund Cleanup decision process is the "Nine Criteria Analysis", which evaluates the remedial alternatives for: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. The "Nine Criteria Analysis" outcomes for the LDW FS 2012 are presented in FS 2012 Table 10-1. The impacts of the presented cleanup alternatives on those who subsist on, work and play in the LDW can be derived from the nine-criteria analysis and interpreted together with risk reduction data from Chapter 9 and using an environmental justice lens to determine the environmental justice implications of the cleanup alternatives. First, the cleanup alternatives may result in disproportionate adverse impacts on segments of the community or the community in general. This can happen through the existing risks prior to cleanup and residual risks after cleanup for community members who consume resident seafood or have contact with sediments along the Duwamish. These community members may experience increased risk in the short or long term due to the cleanup methods used. Second, the type of cleanup and time to implement it has the potential to impact access to subsistence resources, cultural resources, tribal treaty resources, business/economy, exacerbate already heavily impacted environmental/health burdens in resident populations, and public access/greenspace. For example, increased truck traffic during the cleanup could cause traffic and public safety concerns in a heavily impacted transit corridor. It also may have cumulative impacts to environmental media (air, for example), which are already heavily impacted in the Duwamish Valley. The environmental justice implications of the remedial alternatives are further discussed, below.

The modeled risk outcomes are also made difficult to interpret due to the levels of uncertainty in the assumptions and calculations used in the numerical modeling. Although the FS natural recovery model predicts similar risk reduction for all alternatives, it is achieved in varying timeframes with varying levels of uncertainty at varying costs. Model projections for alternatives that rely more on natural recovery are more uncertain than for those that rely more on engineered technologies such as dredging. In particular, model projected sediment and fish tissue contaminant concentrations and risk outcomes are approximations because of "uncertainties in Green/Duwamish River inputs, the effectiveness of source control, natural recovery beyond the construction period, and the potential for contaminated subsurface sediments left in place to be exposed in the future" (FS- AECOM 2012).

The permanence of each remedial alternative in maintaining a cleaner LDW varies according to the methods employed. From the FS (2012), Chapter 9:

"Areas that are dredged yield permanent risk reduction by removing contamination from the LDW waterway. Areas that are capped yield more permanent risk reduction than those addressed by ENR or MNR. Dredged areas require the least long-term monitoring and maintenance. Capped and ENR areas require moderate amounts of long-term monitoring and maintenance to ensure that buried subsurface contamination remains in place. MNR requires a longer period of intensive monitoring to track surface sediment conditions over time until results indicate that contaminant concentrations have reached acceptable levels (e.g., PRGs or long-term values below which further reduction is formally found to be impracticable by EPA)."

The institutional controls (ICs) that are put in place to further reduce exposure in the short and long term could also vary with the cleanup alternatives presented. These ICs may have further implications for inhibiting access and rights, and they may place burdens on community members that preclude important cultural practices. In this analysis, the cleanup alternatives are compared qualitatively for their long term and short term residual cancer and non-cancer risks for different populations; the time to achieve human health targets; the permanence of the methods used to conduct the cleanup; the dependence upon institutional controls; and the immediate ancillary benefits of each alternative for the affected community, such as jobs created; which have implications for environmental justice concerns on behalf of the affected community. The information presented here is taken from Chapters 9 and 10 and Appendix L of the Feasibility Study (2012) with some additional calculations derived from Appendix L. In particular, Table 10-1 (FS 2012), the Superfund "nine-criteria analysis" to evaluate the alternatives, is a primary source of information used in the comparison, below.

Seafood Consumption

Cancer Risk

No remedial alternative presented in FS 2012 is expected to meet MTCA standards for excess cancer risk for tribal adults, tribal children, or API populations. However, all active cleanup alternatives that are presented in the FS 2012, in the long term with sufficient controls, are predicted to significantly reduce risk for populations who consume resident seafood out of the LDW. However, the timing, extent of the risk reduction for different populations, and the potential exposure to short-term increases in risk from resident fish consumption for each alternative varies. In this section, each alternative will be compared to see if and how the alternatives reduce the known disproportionate adverse impacts to local populations who consume resident fish, crabs, and clams from the LDW. Excess cancer risk and non-cancer risk (as a hazard quotient) will both be explored for the major target contaminant of concern (PCBs), for which human health risk estimates are estimated in the Feasibility Study. One drawback of the RI/FS work is that only cancer risk from one contaminant of concern, PCBs, was calculated due to the available data. However, this was justified by the authors of the FS (2012), since PCBs account for the majority of the risk and the excess cancer risk from PCBs is estimated to be of the same order of magnitude as the excess cancer risks from the other contaminants of concern (arsenic, cPAHs, dioxins/furans) taken together (FS 2012).

For tribal adults' excess cancer risk, several alternatives (2R, 2R-CAD, 3R, 3C, 4C, and 5C) resulted in comparable risk reductions and residual cancer risks for tribal adults within 5 years from the start of construction. Risk was reduced from the initial calculated SWAC-based risk of 2 in 10000 from time zero to 3 in 10,000 individuals within 5 years from the start of construction, and by 10 years after construction, the risk was further reduced to 2 in 10,000 individuals, which represents a total excess cancer risk reduction of 90%.The 2 in 10,000 individuals rate for excess cancer risk is the lowest excess cancer risk rate attained for tribal adults during over the model scenario for any cleanup alternative. For alternative 1 (early actions only), the excess cancer risk is reduced within five years to 4 in 10,000, however it also is predicted to reach 2 in 10,000 individuals within 10 years after construction. Similarly, all of the other alternatives, 4R, 5R, 6C, and 6R reach the model lowest-calculated rate of 2 in 10,000 excess cancers after each alternative's individual construction period: 10 years (4R), 15 years (5R), 15 years (6C), and 40 years (6R) (Table 2.1).

Alt #

Cancer Risk Reduction (%) by end of simulation (all individuals)	%									

Achieve Lowest Risk: Tribal Adult (yrs)									
Achieve Lowest Risk: Tribal child (yrs)									
Achieve Lowest Risk: API (yrs)									

Table 2.1: Excess cancer risks and risk reduction and timeframe from each remedial alternative. *CP is construction period. Top two remedial alternatives (or more if more than one are equally effective) are bolded.

The excess cancer risks were ultimately estimated to be reduced by 70% for the tribal child scenarios, and by 75% for the API populations for the alternatives presented, however these reductions occurred over different timeframes for the different alternatives. For the tribal child scenario, alternatives 5C and 6C reach the lowest-calculated excess cancer risk (3 in 100,000, representing a 90% reduction in excess cancer risk) in the shortest time frame – within 15 years for 6C and 20 years for 5C. Alternatives 3 and 4 are estimated to reach this risk reduction after 25 years, and 1 and 2 are estimated to reach it after 35 years, while 6R is calculated to achieve it post-construction, at approximately 40 years. For the adult API scenarios, alternative 5C is calculated to reduce excess cancer risks by 90% after 25 years and 6C is calculated to reduce excess cancer risks the same amount after 15 years. Alternative 4C also is calculated to reach this level after 30 years, and other alternatives are calculated to arrive at this level thereafter, with all alternatives reaching the greatest level of risk reduction after 45 years.

Note that the fact that all of the total excess cancer risk rates converge on a 90% risk reduction over the long term is most likely a factor of the model insensitivity to the assumptions used in modeling individuals' scenarios, in combination with the high PCB concentrations assumed for incoming source waters which swamps other inputs to or influences on the model outcomes. The food web model used to calculate fish and shellfish tissue concentrations of PCBs and reductions due to cleanup rely on upstream contaminant concentrations that are currently found in the Green River. If future water and sediment contaminant concentrations are reduced upstream of the LDW, fish and shellfish tissue concentrations would similarly be reduced by more than what is described in the Feasibility Study 2012 modeled results. The FS values are based upon a natural recovery model with significant uncertainties, and the uncertainties have not been quantified clearly for each population and alternative. Additionally some assumptions, such as reliance on Surface Weighted Average Concentrations (SWACs), rather than the 95th percentile UCL are not conservative. Therefore, these values should be viewed carefully, as concentrations and modeled risks could be quite higher than those presented here, if modeled instead from the UCL95. Overall, alternatives 5C and 6C were found to reach the largest decrease in cancer risk for all populations within the shortest time frames as presented in Tables 9-7a and b.

Non-Cancer Risks

The PCB associated non-cancer risks were reduced from hazard HQs of 40 (tribal adults), 86 (tribal children), and 29 (API), to HQs of 5 and 4 for tribal adults; 10 and 9 for tribal children; and 3 for API scenarios, by the end of the simulation periods (45 years). HQs less than 1 are considered levels where no non-cancer effects are seen, however, it is difficult to compare HQs greater than 1 due to the potential for nonlinearity in responses to a given dose of a particular chemical. However, HQs do provide a gage of how much risk a relative dose provides above the reference dose, particularly for responses that are linear in nature. Alternatives 1 and 2R do not reach the lowest calculated HQs for tribal adults and children within the simulation period (45 years). For the other alternatives, 4C and 5C are the only alternatives to arrive at an HQ of 5 within 10 years, and 6C reaches the lowest HQ fastest, at 15 years (just after construction). All other alternatives (with the exception of 1 and 2R) reach an HQ of 4 by the end of the simulation or end of construction (for 6R only). For tribal children, alternative 5C reduced the HQ the fastest, to 11 by 10 years, and 10 by 15 years, and 4C and 6C also reached an HQ of 10 by 15 years.

Alternative 6C arrives at the lowest HQ (9) the fastest, with other alternatives reaching the value at the end of construction (6R) or at the end of the simulation (4C, 4R, 5C, 5R). The other alternatives, 1, 2R, 3C, 3R, do not arrive at the lowest HQ. For API populations, 4C and 5C reduce HQ fastest, to 4 by 5 years, and all alternatives except for alternatives 1 and 2R reach the lowest calculated HQ, 3, within 15 years.

Alt #

Tribal Adults/Tribal Children/API	3									
Achieve Lowest HQ: Tribal Adult (yrs)									**(CP)**	**(CP)**
Achieve Lowest HQ:										

Tribal child (yrs)										
Achieve Lowest HQ: API (yrs)										

Table 2.2: Non-cancer risk reduction and timeframe from each remedial alternative. *CP is construction period. Top two remedial alternatives (or more if more than one are equally effective) are bolded. Initial pre cleanup HQs are: 40 for tribal adults, 86 for tribal children and 29 for API.

Other Considerations

Residual risks for each alternative were not calculated for the other contaminants of concern, but the alternatives differed in their effectiveness in removing the main risk-driver chemicals of concern at the site (arsenic, cPAHs, dioxins/furans, and PCBs). For all contaminants, alternatives 5C and 6C resulted in the most contaminant removal in the shortest amount of time, with 6C resulting in the highest removal over the shortest period of time. For all contaminants except PCBs, the remedial alternatives are all relatively effective at reducing each contaminant SWAC over the course of the simulation. For PCBs, there are greater differences among alternatives in their end removal efficiencies.

The FS 2012 assumptions include a 2-year window post-construction when contaminant concentrations within the water column are expected to increase for options with in-water work. During this timeframe, it is anticipated that contaminant concentrations in fish and shellfish tissue will be elevated due to sediment stirring and water column resuspension of contaminants. This increase in water column contaminant concentrations may translate to increased resident seafood tissue concentrations during that time, and the time of this increased exposure would likely scale with the amount of in-water work, dredging, and construction timeframe. This resuspension can be minimized with specialized equipment, careful dredging and in-water practices, and sorptive cap material such as activated carbon.

Direct Sediment Contact

Initial direct contact excess cancer risk for tribal adults is estimated to be 2×10^{-4}, which is over an order of magnitude less than seafood consumption excess cancer risks (3×10^{-3}) at the site (FS 2012). Although direct contact risks for each alternative will not be reduced to the MTCA threshold, all alternatives except for Alternative 1 are expected to reduce cancer risks to the same order of magnitude as the acceptable cancer risk thresholds and all HQs to <1 for all populations by the time construction ends, or shortly thereafter. Alternative 1 is expected to reach the on the order of 10^{-6} excess cancer risk for PCBs, dioxins/furans and cPAHs, by 25 years, except for Beach 3 (for cPAHs). Times to reach the 10^{-6} order of magnitude for cancer risk are compared here for each alternative (Table 2.3). Mitigations necessary over the long term for Alternative 1 would include enhanced communication and outreach around contact and exposure minimization, particularly at Beach 3. Although they do not reach the MTCA threshold, the alternatives approach the remedial action objective, RAO 2, in varying amounts of time (Table 2.4).

Alt. #	Alt 1	Alt 2R	Alt 3C	Alt 3R	Alt 4C	Alt 4R	Alt 5C	Alt 5R	Alt 6C	Alt 6R
Time to reach RAO 2	N/A (25 without beach 3)	19	**3**	6	**3**	6	**3**	6	**3**	6

Table 2.3: Time to achieve Remedial Action Objective 2 for reducing risks from direct contact with sediments. Bold indicates the two best outcomes in the shortest amount of time (or more, if tied).

Summary of Disproportionate Adverse Impacts from Human Health Risks Identified in the Risk Assessment

None of the remedial alternatives in the FS 2012 reach the remedial action objective 1 for resident seafood consumption, and thus result in adverse disproportionate impacts for tribal adults, tribal children, and API populations since the cancer risks and non-cancer risks remain above MTCA standards for these populations. Significant risk reduction is achieved with time for non-cancer and cancer risks, which is commendable. However, because of these adverse disproportionate impacts, institutional controls and other mitigations are necessary to ensure that exposure is reduced for the affected populations. These mitigations should take into account any additional risk identified through monitoring, such as higher construction-related water column resuspension of contaminants.

Air Impacts

Appendix L in the FS (2012) includes calculations of cumulative impacts to air from the operation of equipment included in the cleanup options. It is anticipated that rail will be the dominant mode of transport for sediment movement to the landfill in the FS 2012. The rail and other equipment air emissions within the FS are based on the use of typical diesel fuels and other (non-green) base technologies. The calculations include estimates for PM_{10}, which is of most concern for impacts to the surrounding community because of its potential as an irritant to lungs, and its role in lung cancer and chronic illness. The contribution of PM_{10} from site operations for the LDW cleanup alternatives in the FS is very small (highest, for 6R is 2.95 metric tons per year) in comparison to background concentrations of PM_{10}, which are estimated at 383 tons per year for King County maritime operations and 855 tons per year for all PSCAA maritime operations[23] (maritime particulate emissions estimated to be 15% of total particulate emissions for all sources in the area overseen by the Puget Sound Clean Air Agency, PSCAA). However, because air pathways are of high concern for impacting human health within this area, ways these impacts can be reduced should be considered further.

There are many ways to mitigate the impacts from exposures to diesel PM_{10}. The EPA "National Clean Diesel Emissions Quantifier" can be used to assess the ways that green technologies could reduce impacts from rail, trucks, and other equipment. Conversion of dirtier switch locomotives to biodiesel and other cleaner fuel technologies is not unprecedented; EPA has previously funded the conversion of switch locomotives to greener technologies in the San Joaquin Valley. In that instance, it was found that the change in technologies combined with the use of low sulfur diesel, significantly reduced nitrogen oxides and particulate matter concentrations. The West Coast Collaborative (a federal, state, local, and industry partnership) is another mechanism for leveraging resources as they seek out new ways to reduce diesel emissions in transport.

Dredged materials

Another aspect of the cleanup to consider is landfill disposal of dredged materials. At this stage in the cleanup timeline, developing the proposed plan for the cleanup, the exact landfill location which will receive dredged materials is unknown. During the permitting process environmental justice concerns and appropriate mitigations should be considered if the landfill is designated to be within an area with disproportionate and adverse environmental impacts for minority and low income populations. The risk from contact with such materials should be low, if a permitted landfill is used, however, impacts to air from transport of the dredged materials through the neighborhoods on the way to the landfill site in question may be of concern. Again, the use of cleaner-fuel and more efficient vehicles for transport can be one way to mitigate such impacts.

Socioeconomic and Cultural Impacts

Timing of Remediation: Cultural and Social Impacts

The LDW cleanup will have restrictions on when in-water construction can occur to protect the migration of juvenile salmon and bull trout through the LDW. The estimated in-water work window will be October 1 to February 15, which EPA will confirm through consultation with the tribes, the National Marine Fisheries Service, and U.S. Fish and Wildlife Service before implementation. In addition, EPA will need to consult with the Suquamish and Muckleshoot Tribes to ensure that impacts to tribal fishing and cultural events are minimized during remedial activities.

[23] Starcrest Consulting Group, LLC. April 2007. 2005 estimate. *Puget Sound Maritime Air Forum Air Emissions Inventory.* Accessed at www.pugetsoundmaritimeairforum.org

An additional timing concern is the daily operation of equipment in the waterway and transport of dredged materials away from the waterway. Such site operations could impact noise levels and traffic patterns in the surrounding community. Extra traffic could impact local pedestrian access, flow of business in the local area, and commutes. Noise from in-water work and transport of dredged materials may also concern neighbors of the site. EPA will take these concerns into account and will need to work with the community regarding hours of operation of equipment at the LDW site and within the surrounding community. Encouraging the use of equipment outside of residential neighborhoods as much as possible will also mitigate this impact.

Food Access

The LDW site, as a fishing ground for tribes and residents, is a food resource. Impacts that will further hinder seafood access include increased contamination of seafood in the LDW in the short term during and just after in-water work, and the lack of access to healthy resident seafood resources from the LDW in the long term since fish advisories will remain in place for the foreseeable future. Because none of the cleanup alternatives allow for consumption of resident seafood at current consumption rates for tribes, APIs, and others, this represents a disproportionate adverse impact for people who consume resident seafood, and/or who are entitled to harvest resident seafood, from the LDW.

Aesthetics

Since the cleanup alternatives will rely primarily on in-water work, it is not foreseen that aesthetics of the river will be impacted after the cleanup. The cleanup will require restoration of any disturbed areas to their previous state, and thus such impacts should be minimal.

Greenspace

It is not anticipated that the cleanup will negatively affect or impact greenspace in the neighborhoods surrounding the site. However, since this environmental benefit is sorely lacking in these neighborhoods, any activities within WA ECY's source control program, or other agency programs, that can be leveraged to improve greenspace access for residents are encouraged. Should public access or restoration projects be impacted during the cleanup, they should be restored to original state as soon as possible.

Jobs

Job creation and disruption from waterway cleanup activities have been raised by community members, local government representatives, and the LDWG as major concerns for the LDW cleanup. Community members would like to ensure that local residents are given ample opportunity to apply for jobs created by the cleanup, while others have voiced concern that a longer, more expensive cleanup could inhibit business and reduce the number of jobs available to individuals who reside near the LDW. Over 80,000 jobs are located in the LDW area and the

LDWG has emphasized that they do not want the economic effects of the cleanup's magnitude and scope to negatively affect local businesses and their ability to provide jobs in the LDW region. The cleanup options will generate jobs, with the total amount of employment time (number of hours work time over the total length of construction) scaling to the length of the cleanup and the amount of in-water work and volume of sediments handled required for each alternative (Table 2.6).

Alt#	1	2R	CAD	3C	3R	4C	4R	5C	5R	5R-Tb	6C	
Hours	0	158,728	128,882	139,757	211,345	199,646	320,026	220,648	457,334	381,374	476,867	2

Table 2.4: Total worker hours needed for each remedial alternative. Source: AECOM 2012

Comparable sediment remediation sites have created between 500-1000 jobs (e.g., Hudson River PCB dredging). For the cleanup, the King County job training initiative[24], and the Superfund Jobs Training Initiative (SuperJTI[25]) are available for training locals and enabling them to meet the requirements of a particular cleanup and be ready to be hired into the jobs when they are created. Other cleanups have also resulted, on average, with improved economic health for thearea affected, post-Superfund, based on real-estate economy and other local economic indicators (Gamper-Rabindran and Timmins, 2011)[26].

Dependence on institutional controls for and permanence of each alternative

Permanence of the methods used in each alternative and dependence on institutional controls was evaluated through the following factors: total area remediated, construction timeframe, and type of remediation that is conducted. For the suite of alternatives from 1-6R, the relative permanence and reliance on institutional controls is assessed in Table 2.5. For the options with less in-water work, there is stronger reliance on institutional controls in perpetuity, so as not to disturb the underlying sediments and exposure overlying waters to contamination. The options

[24]http://www.kingcounty.gov/socialservices/WorkTraining/ServicesAndPrograms/AdultServices/KCJobsInitiative.aspx
[25] http://www.epa.gov/superfund/community/sfjti/
[26] Gamper-Rabindran and Timmins (2011). "Does Cleanup of Hazardous Waste Sites Raise Housing Values? Evidence of Spatially Localized Benefits." http://econ.duke.edu/~timmins/Gamper_Rabindran_Timmins.pdf

with less in-water work also are less permanent and will rely on more monitoring and evaluation, and re-establishment to ensure that the cleanup methods are working in the future.

Table 2.5: Area affected, institutional controls, and permanence of each remedial alternative

Alternative	Areas: Active Remediated/ Dredge/ Cap/*Habitat remediated; Acres	IC's to be developed	Permanence of action
1	N/A	Use restrictions in perpetuity, all areas Monitoring in perpetuity Fish consumption exposure reduction (advisories, etc.)	n/a
2R	32/29/3/13	Use restrictions in perpetuity; some areas Use restrictions during construction and <RAOs: 24 yr Capping IC's Monitoring Fish consumption exposure reduction (advisories, etc.)	*
3R/3C	3C: 58/29/19/28; 3R: 58/50/8/28; total active/2R=1.8	Use restrictions in perpetuity; some areas Use restrictions during construction and <RAOs, 3C and 3R: 16 yr; 21 yrs Capping IC's Monitoring Fish consumption exposure reduction (advisories, etc.)	***/**

4R/4C	4C: 107/50/51/42; 4R: 107/93/14/42; total active/2R=3.34	Use restrictions in perpetuity; some areas Use restrictions during construction and <RAOs, 4C and 4R: 16 yr; 21 yrs Capping IC's Monitoring Fish consumption exposure reduction (advisories, etc.)	****/***
5R/5C	5C: 157/57/47/59; 5R: 157/143/14/59; total active/2R = 4.91	Use restrictions during construction and <RAOs, 5C and 5R: 17 yr; 22 yrs Capping IC's Monitoring Fish consumption exposure reduction (advisories, etc.)	****/****
6R/6C	6C: 302/108/93/99 6R: 302/274/28/99; total active/2R = 9.44	Use restrictions during construction and <RAOs, 6C and 6R: 16 yrs; 42 yrs Capping IC's Monitoring Fish consumption exposure reduction (advisories, etc.)	*****/****

Table 2.5: Comparison of permanence and IC's needed to enhance the remedial alternatives. *cap includes partial dredge. Ranking is from one star, poorest, to 5 stars, best, outcome.

[need to recheck footprints, above]

Affiliated Agency Programs: Source Control

Much of the remaining risk from the site after cleanup with any alternative will be due to the loading of contaminants from upstream sediment sources. The estimated upstream sediment loading to the LDW, which contains low levels of many contaminants of concern, including PCBs, is >100X the volume of sediments compared to the sediments loading from the lateral and bed sources along the waterway. However, control of lateral sources through an effective source control program is an important component to the overall cleanup and will help reduce the chance of recontamination of the sediments following cleanup. To date, Ecology has been evaluating the lateral contribution of potential sources from approximately 250 outfalls within 24 different drainage basins. Ecology has been charged with identifying and regulating these potential sources to the LDW. EPA and Ecology have agreed to coordinate the sediment cleanup and source control components in an effort to minimize recontamination of the sediments following remediation. Source control will be implemented by a strategic plan prepared by Ecology and several implementation work plans prepared by the agencies and the municipalities responsible for the maintenance of the stormwater systems that discharge to the LDW.

Meaningful Involvement in the Superfund Cleanup Outreach

One provision of EO12898 is to ensure that communities are meaningfully involved in the decision process as much as is practicable. To this end, EPA conducted "A Review of EPA Region 10's Programmatic Response to the Environmental Justice Concerns of the Georgetown and South Park Neighborhoods of South Seattle " ("Review") (EPA 2010), which served as a screening level analysis of environmental justice issues in these neighborhoods. The analysis is specific to the development of the remedial alternatives for the Feasibility Study.

The primary goal of the Review was to examine how EPA programs and activities delegated to other agencies have identified and responded to environmental justice concerns of the South Park and Georgetown neighborhoods. The Review comprised a series of interviews with community members and EPA staff involved in Duwamish work. The interviews were compiled in Addington, 2009, and additional recommendations for EPA's management of environmental justice issues were compiled in Stamper 2009. The major findings of the report are excerpted here and reflect the major community views on the cleanup:

1. *The Duwamish neighborhoods, including Georgetown and South Park, are environmental justice neighborhoods (see Addington, 2009)*
2. *There are a suite of major concerns on the part of community residents:*

- *risks from direct contact with the river*
- *eating fish and shellfish*
- *tracking contamination into homes*

- *controlling on-going upland pollution sources into the river*
- *community access and recreation*
- *habitat restoration*
- *engaging neighborhood youth in environmental projects or internships*
- *synergistic health effects of multiple pollution sources*
- *air pollution*
- *ground water pollution*
- *large number of unpermitted dischargers*
- *lack of community representation in EPA activities (multicultural and multilingual)*
- *underrepresentation of community members in the decision-making process*
- *lack of transparency of interactions between agency delegations, especially between EPA, Department of Ecology, and Puget Sound Clean Air Agency and lack of transparency in delegated decisions;*
- *Continued siting and permitting of questionable facilities in areas of existing industrial high density and placements that are in close proximity to vulnerable populations*

3. There are many concerns on the part of tribes, including the federally recognized Muckleshoot and Suquamish tribes, who have treaty fishing rights to collect shellfish and fish within the Duwamish River. In addition, the Duwamish tribe which, although not federally recognized, historically live along the Duwamish River and maintain cultural ties to it.

- *the appropriate incorporation of tribal fish consumption rates, which are higher than the general population in environmental cleanup decisions*
- *the ability to exercise treaty rights despite EPA activities*
- *the consistency of cleanup actions across all EPA sites along the Duwamish River*
- *the consistency of tribal involvement in EPA's actions*

4. The Duwamish River Cleanup Coalition (DRCC) has provided a bridge between EPA and the community, and it has been key in communicating information about EPA actions and how they will impact the community. The Duwamish tribe is a member of the DRCC, and so the Duwamish tribe's views are presented by DRCC at EPA meetings and are represented in DRCC's communications with EPA.

5. There appears to have been a real effort by EPA, Ecology, and other agencies involved with the Duwamish cleanup (with delegated source control programs) to *respond to community concerns.*

- *EPA has conducted public meetings and provided factsheets and documentation to support the community with translation in multiple languages.*
- *Overall, EPA Superfund has done an excellent job of integrating community involvement with Risk Assessment and Sediment and Source Control. This is not to suggest that all community concerns about risk of impacts from the Superfund site have been addressed, addressed adequately or to the community's satisfaction.*
- *Tribal consumption rates were incorporated into EPA decisions*
- *WA State Department of Health has issued fish consumption advisories and fish preparation instructions in a variety of languages*
- *Ecology has implemented a Lower Duwamish Source Control Work Group (SCWG) to better prioritize and control the loading of untreated combined sewer overflows into the Duwamish*
- *Superfund Community Involvement, RPMs and the entire Duwamish Team has done an excellent job at involving segments of the community in Superfund processes and decision milestones.*

Active residents of South Seattle communities and advocates seek a comprehensive and holistic approach to environmental, public health and social issues at play in the area. The call of community members and advocacy groups and agency allies for cumulative and multiple impacts analysis is an example of this. However, the Superfund program is not flexible enough due to statutory structure to deal with a variety of additional environmental and public health concerns expressed by communities that fall "outside" of the Superfund site. Similarly, while Community Involvement staff are quite successful in creating opportunities for meaningful involvement on the Superfund site, they are not in a position to formally play a role in addressing other environmental and public health issues in the broader area. Consequently, issues outside the Superfund site itself are covered by a patchwork of largely uncoordinated agency activities, which tax the community's ability to pay attention and participate effectively or to understand agency interactions and accountabilities.

Community and tribal comments and concerns have been received on the draft Feasibility Study during an early, additional comment period from October through December, 2010. This additional comment period was not required by law and was intended to elicit comments early in the process, and in subsequent correspondence. Consultation and discussion with the federally recognized Muckleshoot and Suquamish tribes and tribal representatives has taken place regularly during the FS development and EPA review process. DRCC/TAG, the local Community Advisory Group described a new option, "Alternative 7", which emphasizes source control and where the remedial action level is set to natural background (2 µg/kg dw for PCBs). Similar to the FS alternatives, Alternative 7 would include two variations, with 7C comprising a mixture of technologies, and 7R emphasizing removal/dredging of contaminants and upland source control, with the ultimate goal of negating the use of post construction institutional controls. Individual comments on the draft FS varied widely, with some emphasizing efforts to reach substantial risk reduction in the quickest way possible, and others emphasizing efforts to reduce contamination in the longer term. Some comments showed a willingness to focus on achieving short-term results and avoid long-term impacts on the surrounding communities. Furthermore, many business and industry groups specifically endorsed alternative 3C.

Tribal comments also supported cleanup alternatives that emphasized permanence/stability while preserving their right to resources available from/at the river. The Muckleshoot Tribe indicated that the FS was not sufficiently detailed to enable the options to be contrasted effectively, while the Suquamish Tribe asserted that those most vulnerable to the health hazards presented by the site should direct the selection of the alternative.

Institutional controls, mitigation measures, and offsets

Institutional Controls

Institutional controls (ICs) are administrative and legal instruments intended to minimize the potential for human exposure to contamination by limiting land or resource use and influencing human behavior. In addition to protecting human health, they also play an important role in Superfund site cleanup by protecting the integrity of engineered remedies. They are not, however, intended to be primary solutions or to be used to avoid more costly engineered solutions. Because no alternative that has been proposed will clean up the river enough to lift fish advisories, institutional controls will play a strong role in reducing risks from the site. However, institutional controls are controversial from an environmental justice perspective, and so they warrant further detailed discussion here.

Primary categories of ICs include:

- Proprietary controls - prohibit activities that may compromise the effectiveness of the response action or restrict activities or future resource use that may result in unacceptable risk to human health or the environment.

Examples: easements and covenants

- Governmental controls - restrictions on land use or resource use, using the authority of a government entity.

Examples: zoning; building codes; commercial fishing bans; sports/recreational fishing limits

- Informational devices - provide information or notification to local communities that residual or contained contamination remains on site.

Examples: State registries of contaminated sites, notices in deeds, tracking systems, and fish advisories.

- Enforcement tools - legal tools, such as administrative orders that limit certain site activities or require the performance of specific activities

The Government Accountability Office has recognized a trend in Superfund cleanups where institutional controls are being relied upon more heavily as wastes are left in place and not removed completely. They have strongly suggested that EPA review institutional control recommendations, methodologies, and guidance documents to ensure that institutional controls are effective during the time they are needed, and that appropriate contingencies are in place for the long term (GAO 2005[27]). The report found that remedy decision documents lacked information about: implementation including timing of institutional controls, responsibility for monitoring of effectiveness, and enforcement responsibility.

Institutional Controls in the Feasibility Study

ICs are presented in the Draft Final Feasibility Study (FS 2012) as necessary to achieve remedial action objectives (RAOs) in addition to the engineered controls. This is particularly true for RAO 1, which is intended to reduce health risks associated with consumption of resident fish and shellfish. Institutional controls are required to adequately protect consumers of resident fish and shellfish, because none of the remedial alternatives are predicted to reduce sediment and water concentrations of contaminants to allow for unlimited seafood consumption at high (e.g., tribal and API calculated RME rates from the risk assessment) consumption rates. The ICs discussed in the FS 2012 are primarily proprietary ICs to preclude damage to caps and other protective cleanup systems in place, and which would be controls on activities such as anchoring, pile driving, dredging, etc., where protective caps are in place. The main ICs for reducing the health risk from consuming resident fish at the site over the long term that are mentioned in the FS 2012 comprise informational devices, which include: monitoring, public outreach, education, a public hotline, and a seafood consumption advisory. The FS 2012, in its overview of ICs, mentions that a more detailed implementation plan will be developed to meet specific location and local community needs.

[27] http://www.gao.gov/assets/250/245140.pdf

All of the alternatives rely on the use of seafood consumption advisories as an IC to protect consumers of resident fish and shellfish. The more significant differences among the alternatives include the amount of acreage controlled through other types of ICs, including proprietary controls, monitoring and notification of waterway users, enforcement tools, and site registry. These will be more significant for those alternatives that emphasize capping, enhanced natural recovery, and natural recovery, such as Alternative 2. Informational devices, including design, monitoring, and outreach, account for much of the estimated 30-year costs of implementing ICs according to the FS 2012.

Other ICs that may be relied upon at the LDW site include technical engineering controls to ensure the integrity of sediment caps and other devices put in place to contain contamination. ICs could limit the range of activities allowed at the location or materials used in creation of the cap or other sediment device could preclude certain activities. Likewise, new technologies would need to account for future uses at the site, and site design and preparation should account for tribal rights and fishing resources that coincide with the site. The depths for caps should allow for full depth needed for the range of burrowing organisms found in the LDW. They also should be sufficient to allow for anchoring, clamming, and other tribal treaty activities to take place in the future. Any institutional controls in place that limit access or activities, again, should be temporary to the extent possible.

Institutional Controls: Effectiveness

A report prepared by the National Environmental Justice Advisory Council (NEJAC) in 2001 (revised 2002)[28] on fish consumption includes a thorough illustration of how EJ issues related to ICs such as fish advisories. From a theoretical standpoint, informational campaigns place the burden of addressing environmental contamination's health effects on those affected, rather than those responsible for the risk. In the case of the LDW, there is anecdotal evidence that current fish advisories, which are on prominent signs in multiple languages, are currently ignored (Figure XX). Additionally, fish advisories, in attempting to restrict or influence behaviors, assume that there are accessible substitute food sources for the fish consumers and that changing behavior is appropriate.

The use of fish consumption advisories within the LDW is complicated as an environmental justice issue. For example, those who are subsistence or tribal fishers on the LDW may have no viable alternative food sources, particularly if alternate fishing locations are too expensive to access or require new skills and fishing knowledge. Advising fish consumers of the LDW to avoid eating fish may be akin to recommending abandonment of their cultural heritage and

[28] For example, National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

identity[29]. Restrictions on fish consumption may also lead to short- and long-term changes in diet with significant health consequences. At the same time, given the reality of potential exposure to toxic contamination for LDW fish consumers, simply avoiding the use of informational devices may result in the environmental injustice of real harm to people from consuming contaminated fish. A middle ground, as advanced in the NEJAC report, is to adopt fish advisories that are culturally appropriate, informed by community expertise, supported with necessary funding, and managed or co-partnered by those affected. In addition, ICs must be understood to be temporary measures, as limited in scope and duration as possible, and designed to complement other mitigation measures to prevent and reduce the sources of contamination that necessitate short-term advisories. Promoting alternative fish resources that are healthier is also an institutional control that reduces exposure without providing the erroneous message that all fish should be avoided, which has been an unintended consequence of other educational/advisory programs[30].

One Superfund example of enhanced community outreach which includes fish advisories as institutional controls is the Palos Verdes Shelf (PV Shelf) Superfund cleanup site. At the PV Shelf site, a large effort went into forming a community advisory group, the Palos Verdes Shelf Fish Contamination Education Collaborative (PVS FCEC[31]). The PVS FCEC conducted outreach with and surveyed the community in order to enhance educational messaging. A partnership of federal, state, local, and community-based organizations was formed, and the partnership developed and jointly implemented institutional controls. In addition, surveys were targeted to the different fishers, using culturally-relevant and appropriate questioning to assess both how well the fish advisories were working, if the advisories resulted in behavioral changes, and what the changes were. This information could be used to evaluate the full impact of the advisory on culture as well as exposure. Targeting educational information to the groups with the greatest health risk, such as pregnant women, women of child-bearing age, and children, was found to be important. Follow up surveys were able to evaluate the effectiveness of previous outreach efforts and enable changes to outreach efforts as the cleanup takes place. Other useful tools employed at PV Shelf included a comprehensive in situ monitoring program that is still used to update the fish advisories. PV Shelf also targeted restaurants that bought contaminated fish for monitoring and education.

It should be mentioned that the PV Shelf case differs from the LDW in that there is some regulation around catching of the target fish in PV Shelf, and in the LDW case no prohibition or

[29] See, e.g., O'Neill C. 2000. "Variable Justice: Envrionmental Standards, Contaminated Fish, and Acceptable Risk to Native Peoples", 19 Stanford Environmental Law Journal, 3:43-44..

[30] For example, National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

[31] www.pvsfish.org

regulation is in place to restrict catching of resident seafood (and they are not sold to restaurants to our knowledge, and restaurants were a focus of PV Shelf activities). The lack of enforcement capability with fish advisories undermines their effectiveness for their intended purpose – as institutional controls. According to Superfund guidance, institutional controls should be enforceable, and thus concerted efforts must be put forth to increase the effectiveness of fish advisories when used, to rely on them as temporarily as possible, and to acknowledge the burdens placed on the individual and the individual's behavior rather than on the cleanup itself.

It is important to place value on the culture of the ethnic groups who fish in the LDW when disseminating information about the human health risks associated with fish consumption. Different ethnic groups rely on different communication methods. For example, showing respect for and including tribal cultural practices such as oral traditions, and allowing for exchange of information orally, likely will be important in the LDW given the presence of tribal fishers and their usual and accustomed and traditional fishing area. Furthermore, different types of media may be used more or less frequently by different ethnic groups; television, radio, newspaper, and electronic media including social media. For some groups, only direct person to person communication will suffice. This is an important consideration as well for reaching intergenerational groups. Allowing for culture in the development of institutional controls can lead to improved long term stewardship of the resource and involvement/empowerment in decision-making.

One outcome to be avoided is overall reduced consumption of fish, as it is a nutritive food source. In some follow-up survey work, advisories have been found to have resulted in mis-messaging, such that all fish sources were seen as corrupt rather than those that were the sole target of the advisories[32].

Community Input on Institutional Controls in the Draft Feasibility Study

Community input was sought throughout the remedial investigation and preparation of the draft feasibility study. Of the more than 300 letters received by community members and other stakeholders during the comment period from October-December, 2010, a number of concerns were raised regarding the effectiveness, appropriateness, and description of ICs recommended in the draft FS. The majority of these remarks mirrored the concerns expressed in the NEJAC report, while some commentators recommended specific ICs and related mitigation measures.

Key comments related to the FS discussion and implementation of ICs included the

[32] National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

following:

- Revision of FS to better reflect EPA's site manager guidance on ICs and other best practices.
- Concern that IC cost estimates are underestimated and lack detail.
- Call for additional discussion of ICs, including more detailed descriptions and cost estimates for each alternative, as well consideration of short-term, remedial, and long-term implementation.
- Request for additional measures to mitigate the consequences of relying on behavior change strategies and the additional health, cultural, and EJ impacts of fish advisories and restrictions.
- Greater consideration of source control and more extensive clean-up options rather than relying on ICs. Specific IC measures or processes identified through community input included:
- Establishment of a collaborative body to implement the IC program.
- Education designed to reach multiple communities in culturally-appropriate and easily accessible locations and formats.
- Tools to educate and empower affected populations to improve the health of seafood resources, including local job creation.
- Community-determined mitigation measures (such as transportation to healthy fishing locations, delivery of healthy seafood, community aquaponics, etc.).
- Community health clinic training, especially about health risks for children and women during pregnancy and breastfeeding.

Of particular concern from an environmental justice perspective is the use and reliance on institutional controls. For options that rely more heavily on in-place containment and less on removal, the dependence on institutional controls is stronger. Institutional controls in practice and as mechanisms to mitigate adverse disproportionate impacts will be discussed in section VI. Another related topic is the use of activated carbon and/or other new technologies as remediation methods. The tribes have raised concerns that the use of the new technologies without adequate testing could result in adverse effects on fisheries and ultimately their treaty fishing rights. Although the new technologies are predicted to reduce contaminant concentrations within the water column, the tribes are concerned about potential impacts to the benthic prey species which their target fish and shellfish rely on. Adequate pilot testing is essential for understanding where such technologies can be applied effectively, and to better understand the impacts to the organisms that live in the LDW.

Potential Findings and Conclusions

-IC design, implementation, monitoring, and evaluation should be driven by community experts, with the funding and expertise necessary so that this does not further burden those affected.

-Outreach, education, and information campaigns cannot be designed to promote behavior change; rather they must be designed to facilitate risk communication, with additional funding and expertise for communities to determine appropriate and effective responses to unavoidable risks. Behavior change may be one strategy but it is not necessarily a recommended or helpful strategy, particularly given the questionable effectiveness of most fish advisories and negative health and cultural impacts of ICs.

-To mitigate the negative consequences of ICs, which are compounded for EJ communities, additional measures are needed to ensure that safer seafood alternatives and information on safer seafood alternatives are available. Without these additional offsets to reduce exposure (and necessary funding and expertise), ICs represent an additional harm to EJ communities, potentially leading to proposed alternative that fail to meet threshold criteria.

-Alternatives that depend on longer-term ICs are not preferred from the perspective of EJ. The results of the FS show that seafood advisories will be permanent over the long term (Appendix I), however, the tenor of the advisories (whether the content of the advisories will change as the cleanup progresses) and education efforts that will be needed around the advisories should be clarified and addressed.

Other ways to mitigate adverse impacts

In the context of the LDW Superfund cleanup, mitigation measures are methods to reduce the impacts of the cleanup techniques and options in order to reduce cumulative impacts during the cleanup. Many successful mitigation measures have been developed during the cleanup of the Early Action Areas, and successfully promoting their use in the full LDW cleanup would similarly improve outcomes for community members.

First, given the excessive asthma hospitalization rates, excess lung cancers and other impacts to air pathways for residents in the vicinity of the LDW, it is advised to use the cleanest technologies available for equipment associated with air impacts. Particular concern should be given to idling of equipment near residences, schools, childcare facilities, and elders (eldercare, senior housing). Electric construction equipment, emissions controls, low sulfur fuels, biodiesel, and other environmentally friendly sources of equipment are one way to reduce emissions and local impacts to air. In addition, a primary construction element used in cleanup of the Slip 4 early action area and under consideration for subsequent actions costed out in the Feasibility Study is the use of a direct rail spur (staging-barge-rail) for delivery of sediments out of the

LDW neighborhoods. The use of rail would lessen the impact of truck traffic in an area where truck traffic, idling, and diesel emissions are all sources of concern for the neighborhoods from both safety and clean air perspectives. Although rail is not emission-free, the majority of emissions generated would likely be outside of the footprint of the Georgetown and South Park neighborhoods. Additionally, green rail techniques could be implemented, and community input on timing of rail crossings could be included. Using low sulfur fuels, filter systems, and even biodiesel-based engines are possible, with varying levels of emissions-reductions and cost, but provide significant benefits to air quality. For necessary truck and equipment transport and operation, a community advisory group or other transparent forum for immediate feedback to the site manager would be essential for designing ideal routing and timing, which would maintain low impacts on residents surrounding the LDW.

Cultural impacts and recommendations

Regarding disruption of cultural resources and barriers to access for ceremonial events, a way to inform activities in the LDW and prevent or minimize impacts to such resources would be a cultural resources survey for the LDW. A map or other tool with resource listings and timeframes for resource usage could help to avoid adverse impacts during the cleanup process. Or, alternatively, the use of a shared schedule identifying the resource and timeframe for its use compared to cleanup activities should be generated.

A historical and cultural resources survey will be conducted prior to remediation of the site. However, having such information in hand as soon as possible during cleanup planning would minimize community impacts. A community resources and activities watershed map has been developed by the DRCC for the Duwamish River, including the LDW. Other layers could be added to the DRCC base map with events and timeframes of the resource use, and overlaid with the cleanup site preparation. The map could be provided online to promote clear and quick communication, or be posted in affected communities to provide updated information on the cleanup, and with contacts for questions and concerns. Separately, for federally recognized tribal treaty activities, regular consultation, well in advance of the design, cleanup activities and milestones, must be planned to avoid or offset impacts to fishing activities and other uses of the LDW.

Offsets

Offsets are the temporary substitution of healthier seafoods or bolstering of healthier seafoods as alternatives to consuming contaminated resident seafood from the LDW. In the event that the cleanup alternative chosen leads to higher contamination/unacceptable risks from consuming fish from the waterway in the short term, or local users of the waterway are prevented from accessing a cultural or subsistence resource, offsets may be required to reduce exposure and/or increase access to resources. These offsets could include:

- providing maps of other fishing locations with less contaminated resident species,
- the provision of clean seafood to local residents in the LDW,
- fish trading where less contaminated seafood such as salmon or vouchers for seafood are substituted for resident fish when caught by local fishers,
- transport of fishers to accessible/cleaner fishing locations,
- direct compensation for loss of fishing rights or access,
- community enhancements or infrastructure projects that can substitute for LDW and LDW resident seafood fisheries access in the interim (including sustainable aquaculture or aquaponics projects), or
- reduction of exposure through indirect methods including enhanced habitat restoration to enhance populations of cleaner LDW fish stocks (salmon), upland source control infrastructure projects, and other ways to reduce the flux and net impact of contaminants on fisheries and human health.

While not ideal, the provision of an alternative source of fish, promotion of healthier alternative fish resources, and/or, the bolstering of anadromous fish resources (salmon) that are a healthier seafood consumption alternative either through habitat or general sustainability improvements upstream and in the LDW, could provide an offset for the short-term increased risk/restrictions from eating resident fish from the LDW during active construction and remediation. Contingencies and much planning and data gathering would be involved for provision of fish from an alternative source, including monitoring of the alternative fish source and ensuring that the fish source is an appropriate substitute from the perspective of those who consume resident seafood from the LDW. Some challenges that can be foreseen include not knowing who is currently fishing, who relies on fish from the LDW, and more recent data on seafood consumption patterns, including what seafood and parts of seafood are being consumed, and who is consuming the fish (age stratification, diversity, etc.).

Community infrastructure projects could range from enhanced park and recreation access (while the LDW has limited access or parks available), community land-based hydroponics or aquaculture projects, or green building and infrastructure programs. For tribal members, it may be difficult to find an appropriate offset or mitigation, and any acceptable offset would have to be developed through government to government consultation. For example, community infrastructure projects, such as local aquaponics projects, depending on the type of project and the tribe's role, could have little relevance to tribes. However, aquaponics and land-based aquaculture has been used in a reuse context at Superfund sites such as the AMCO Chemical Superfund site, Oakland, C.A., and an aquaponics system is under consideration at the Portland Harbor Superfund site. Tribes also use land-based aquaculture such as fish hatcheries to bolster salmon stocks in rivers around Puget Sound, including the Green-Duwamish.

Improving the quality of the stormwater from the uplands is an important component to improving the water quality of the river. Ecology is preparing a source control program that will coordinate source control plans developed by the local municipalities with the current Ecology water quality program. These source control efforts would help reduce total exposures from the site, and by leveraging the work with Puget Sound restoration efforts, could give a boost to the LDW. Also, reducing nonpoint source pollution with green infrastructure projects in the Duwamish Valley, while at the same time providing more green space, would greatly benefit the South Park and Georgetown communities, enhance livability, and mitigate cumulative impacts, as well as reduce exposures from lateral source loading. If such green infrastructure projects include green buffers around transportation corridors, the cumulative impacts to air for local neighborhoods bordering the LDW could be lessened as well, which could offset the air pollution impacts due to construction associated with the river cleanup. Infrastructure programs in the form of financial support or incentives for businesses, residents, and mobile sources (travelers) to reduce contaminant loading to stormwater and particularly air deposition of contaminants through greener methods, control technologies, and infrastructure projects would also be welcome ways to leverage additional community benefits from source control programs.

Summary of impacts and recommendations

The EJ analysis has shown that there are many places where EJ concerns exist and mitigation for adverse disproportionate impacts are recommended. Where disproportionate adverse impacts are measured or unavoidable, first consider mitigation for the impacts experienced, and secondly, consider compensation or substitution for any loss of access to fisheries or other resources.

1. First, multiple cumulative impacts are present in the South Park and Georgetown neighborhoods and other areas flanking the LDW, with particular concern around air emissions.
2. Secondly, some local fishers and tribal members may consume more fish than average and may experience disproportionate health impacts from contaminants in fish tissue, compared to the average person.

3. The remedial alternative chosen may create disproportionate adverse impacts in the short term, as even higher contaminant concentrations may be found in seafood during construction. It should be noted that the existing disproportionate impacts from seafood consumption will not be fully removed by any remedial alternative.
4. From an environmental justice perspective, the focus of the cleanup should be on decreasing health risks from fish consumption as much as possible; minimizing impacts

to cultural and recreational uses of the river; while at the same time avoiding or minimizing the use of institutional controls over the long term.

5. Instead of ICs as a long term measure, the cleanup should ensure the permanence and reliability of the solution in place, and monitoring should provide reassurance that the solution stands the test of time.

Fisheries Impacts

Although offsets and institutional controls to reduce risks are important to reduce short term exposures, they are not meant to be long term solutions to the problem. The cleanup method chosen should reduce the environmental health burden of the contaminated waterway for users of the LDW, tribal treaty fisheries and subsistence/recreation fishers. The cleanup should not rely heavily on making the burdened population change practices and culture over the long term. For many tribal populations, the future outlook for seven generations ahead is traditionally considered in tribal decision making. Keeping cleanup options open to consider new technologies and improvements in the future, flexibility to meet stricter targets, and employing adaptive management at the site is consistent with that view. Habitat that is disturbed in cleanup should be returned to its prior or improved state as soon as possible as the cleanup progresses and tribal representatives should be consulted on habitat restoration. Only through working closely with community liaisons and consulting separately with the tribal governments the appropriate and acceptable mitigations and offsets can be determined during cleanup.

Communication and Coordination

Enhanced communication and coordination should be a feature of this cleanup. The local communities have been engaged in the process thus far, and outreach should continue to be culturally relevant, targeted and create a space for exchange and discussion to achieve the best cleanup outcome possible. Outreach should make an effort to engage the full diversity of individuals who live, work, and recreate, in the LDW. Joint community/nonprofit/agency advisory committees for outreach and community involvement and tribal coordination on an institutional controls development program, will be key to the success of such programs and ultimately the cleanup itself.

This coordination is crucial, because of the high volume of activities along the Duwamish, including cleanup of the early action areas, and research projects in the vicinity. Community fatigue is also present and any communication that needs to take place should be as streamlined as possible. Upstream and lateral source control should also be a topic for the enhanced outreach conducted by the institutional controls and enhanced community education groups. Leveraging of source control work (to improve green space quality and provide buffer zones for air and water where possible/practicable) can reduce cumulative impacts to the neighborhoods surrounding the LDW. Joint mapping and scheduling software with continuous information sharing, including areas of progress on the cleanup sites, overlays with significant cultural, ecological, and recreational resources, would allow for more seamless discussions and a level playing field when soliciting community input on tradeoffs in design. For those who do not have internet access, meetings within the community to discuss and solicit input will also be necessary. Furthermore, a comprehensive fish and shellfish-tissue monitoring program that is in place to ensure the reliability of institutional controls and integrity of technologies in place, and also can be used to inform health advisories over the long term, will be a critical data-sharing tool.

Source Control

The continued success of the cleanup for the long-term depends on the ability to control sources via a strong source control program. Although lateral source control is the focus of Ecology's source control program, a joint agency effort to assess how to leverage resources to address sources of contamination upstream, and how to disseminate information to better protect waters and communities downstream, would greatly benefit the people who live, work, and play in the LDW region, and would enable federal agencies to uphold their tribal treaty trust obligations to ensure sustainable resources for tribes in the future. Just such a program, called an Urban Waters Pilot Initiative, has been proposed for the watershed of the Green-Duwamish River, and it will involve numerous local, state, and federal agencies, nonprofits, industry, and other partners.

Addressing Data Gaps

Data gaps in this analysis are many, and new data sources could improve the analysis and recommendations. Very limited data are available on local fishers in the LDW (although some data are available for the Duwamish River as a whole). The existing data have revealed some basic fishing and consumption patterns. More detailed data are critical for targeting outreach and communication, involving the community in a meaningful way, addressing health risks effectively, and designing the institutional controls program. Understanding environmental health and cumulative risk faced by the population consuming fish caught by local anglers in the LDW is complicated by this lack of information. It is possible that some local fishers reside far from the LDW, with different environmental health and burden characteristics than those from the LDW.

Another complication for this analysis is that county health data were not statistically significant at the resolution of the individual neighborhood block and block group levels which would be needed to do more quantitative cumulative health risk comparisons or screenings. Instead, a more general cumulative impacts assessment was provided here, along with relevant studies/information on background sources of pollution to multiple pathways. However, more epidemiological research would help target with a finer lens the health and related environmental burdens and benefits/improvements that could be made for residents in the area directly surrounding the LDW.

Defining institutional controls timeframes, details, and accountability/responsibility will be critical and will take a multi-agency and group approach, and this should take place as soon as possible. Non-proprietary maps of important local resources and community interviews and engagement, including oral recordings of traditional environmental knowledge, would have been useful in developing this assessment, but are still critical for the development of the proposed plan and design, and in working with affected populations in the future.

Recommendations for the proposed plan

- Emphasize reduction of greatest human health risks as soon as possible while ensuring that cleanup methods used will be effective and last over the long term;
- Formation and funding of an advisory group with support for local community outreach experts to meaningfully involve the community in developing the most appropriate mitigations for exposure from eating resident seafood at the site;
- Continued support for tribal consultation, participation, and early involvement;
- Supporting a local fisher consumption survey specific to the LDW (where, when, what they are fishing for to provide critical information in the development of institutional controls, offsets, and enhanced education);
- A mechanism to provide offsets in the event of higher short term concentrations in fish tissue in the LDW: fish trading may be most straightforward, but there would be cost savings potentially through a sustainable aquaculture or alternative transportation method; offsets for tribes to be developed in consultation
- Green remediation techniques are used with any cleanup alternative chosen

Recommendations that would be voluntarily adopted

The recommendations listed below, while not necessarily to be identified within Superfund's LDW proposed plan or record of decision, could be considered through other programs or processes:

- Coordination around source control and environmental justice concerns; buffer zone and greenspace enhancement where possible
- Funding training for local workers and local hiring
- Traffic, health, and safety coordination
- Health screening

Future work and vision for Duwamish Valley

Community Visioning

Several visioning efforts have taken place among the communities along the Duwamish River, and can lend insight into how EPA and other involved parties can inform our roles in the cleanup and selection of cleanup options and how our work will ultimately impact the affected communities where environmental justice concerns and disproportionate adverse impacts exist.

The members of the South Park Neighborhood Association conducted a visioning process, where they listed many aspirations including those below that have a nexus to the activities in the LDW:

> *With a thriving retail core surrounded by pedestrian-friendly residential and industrial uses that together create a welcoming and safe environment;*
>
> *Where children and youth feel safe and enjoy a broad array of recreational and scholastic opportunities, using a variety of public and private facilities;*
>
> *Where residential, commercial, and industrial interests are considered on an equal basis to create a pleasant living environment, abundant job opportunities, and successful, environmentally responsible community;*
>
> *That takes pride as Seattle's only riverfront village, practices responsible stewardship of the river, and supports a variety of commercial, industrial, recreational, and wildlife uses along the river;*

Furthermore, in a separate visioning process conducted by DRCC and summarized in the "Duwamish Valley Vision Report" (2009), four broad categories were used to define the visioning process, and aspirations were developed based on this scoping:

1. Environmental features, including air and water quality, parks, habitat, and open space

2. Community amenities, including housing, social services, public art and recreation,

3. Transportation, including basic infrastructure, public transport and freight mobility,

4. Economic development, including industrial uses, redevelopment and small businesses.

The aspirations that followed the visioning process included:

1. A Duwamish Valley with clean air that no longer poses health risks to area residents. *Strategies for reducing air pollution that were identified by visioning participants include stricter regulation of industrial air emissions; reducing vehicle traffic, commuting and idling, especially by trucks in residential neighborhoods; and planting more trees to help*

filter pollutants and improve air quality throughout the Duwamish Valley

2. The need for clean water with a focus for protection of water quality in the Duwamish River and the Valley's streams and creeks.
   Strategies for reducing water quality impacts included stormwater controls such as bioswales and other green infrastructure projects; natural drainage systems; porous sidewalks, driveways and parking lots; and use of wetlands as stormwater treatment ponds
3. Duwamish River Superfund site will be successfully cleaned up and that people will be able to safely play on its beaches, swim in its waters, and harvest and eat fish, clams, crabs and other seafood from the river.
   Strategies include securing a clean up of the Duwamish River that is "done once and done right", and include controls on sources of contamination.
4. Restored habitat for restoring habitat for fish, birds, wildlife and people.
   Strategies include removing armoring, creating connected restoration and in-water habitat sites as a habitat corridor for juvenile salmon and other organisms, daylighting lost creeks, connecting greenbelt areas, restoring bends and mudflats where possible, and create or restore lakes to encourage diverse wildlife.
5. Creating a livable community with better greenspace access, particularly in Georgetown.
   Strategies include creating more parks and greenspace, dog parks, and noise/pollution buffers.
6. Increased public access to the river.
7. Alternative energy and a green economy through green jobs and businesses sourcing.

EPA and other Agencies' Programmatic Efforts in the Duwamish Valley

EPA and other agencies involved in the cleanup share a long term vision for a cleaner river and healthier communities for those who live, work, and play in the LDW. Many of the environmental health concerns mentioned here have causes or are related to issues beyond the scope of the LDW Superfund cleanup. It will take holistic action on the part of all agencies to determine a path forward for addressing these impacts.

For EPA, many programs in the Regional Office in Seattle, WA, have made and will continue to make concerted efforts to address the environmental burdens identified in South Seattle. EPA's work is cross-program, including efforts to improve air and water quality, clean up toxics, improve access to green jobs and remediate brownfields sites. The Region 10 Office of Water and Watersheds is working with the Washington State Department of Ecology to develop a Water Quality Assessment for the Lower Duwamish Waterway. This Water Quality Assessment will examine the relationship between the pollutant loading in the watershed and the impairments that have been identified in sediment, fish tissue and water quality samples in the LDW.

EPA has funded many grants to do work along the Green and Duwamish Rivers and in the

LDW. This works includes grant-making to the Northwest Indian Fisheries commission and Muckleshoot Tribes to evaluate and improve salmon spawning and migration routes. EPA has provided grants to King County to control sources and implement stormwater-controlling low impact development projects in the Duwamish/Green River watershed. Other EPA grants have funded community groups, including DRCC, to look at Cumulative Health Impacts in South Seattle and a Community Action for a Renewed Environment (CARE) grant has been used to help South Park and Georgetown to identify their environmental health priorities. Many agency staff regularly take part in the South Seattle Environmental Justice Interagency Work Group, which is helping coordinate the multitude of activities that agency, industry, and community groups are conducting along the LDW.

EPA has produced GIS frameworks and databases with environmental data and created reports, such as the Toxics Release Inventory Report for Seattle, WA, based upon EPA and other data to distinguish the major environmental and environmental health concerns here. Much compliance and enforcement remediation work has focused on the reduction of PCB contaminated soils and paint. EPA and ECY have targeted further inspection and enforcement activities in the Duwamish watershed, and ECY, in particular, has focused on multimedia inspections along the LDW. EPA has also funded the King County Green Jobs training initiative for several years, as well as brownfields redevelopment initiatives in South Seattle. [KC agency summary to be attached as appendix B]

[Appendix A: King County Health Statistics for the Duwamish Valley, 2010]

To be attached as excel spreadsheet

Appendix B { Seattle and King County Summary of Social Justice and Equity Initiative Efforts in South Seattle}

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
Bcc: []
From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Tue 12/18/2012 4:22:07 PM
Subject: Re: Draft cover letter for FS comments
DEC13DRAFT FS COMMENTS COVER LETTER lc rev.docx

Deb,
Here are my proposed revisions.....maybe we should just say doc is not approved... but take a look at a possible alternative in the attached, I think it can work... a few other comments as well.

thank you

Lori Cohen, Associate Director
Office of Environmental Cleanup
U.S. EPA Region 10
ph: 206-553-6523

From: Deb Yamamoto/R10/USEPA/US
To: Lori Cohen/R10/USEPA/US@EPA
Date: 12/14/2012 09:52 AM
Subject: Draft cover letter for FS comments

Lori,

Attached below is the draft cover letter for the FS comments. This letter provides the "big picture" concerns we have with the FS and identifies the process for revision. If you want to see the comments that will be attached, let me know.

Deb

[attachment "DEC13DRAFT FS COMMENTS COVER LETTER dyfin .docx" deleted by Lori Cohen/R10/USEPA/US]

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
Cc: CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Fri 1/25/2013 5:20:22 AM
Subject: Re: PLEASE READ: FYI- LWG "feedback" concerning announcement of EPA comments on Draft FS
EPA comments on the RI/FS Draft Baseline Ecological Risk Assessment
EPA comments on the March 2012 Draft Study Feasibility Study
Portland Harbor Baseline Human Health Risk Assessment Dispute Decision
Portland Harbor BHHRA Dispute Decision Memo - Partial Resolution
Proposed Confined Disposal Facility Questions and Answers
Subscriber Preferences Page
support@govdelivery.com
U.S. Environmental Protection Agency - Region 10
Hotspot

Thanks for the updates...please be sure to schedule time to discuss PH issues on Monday before our trip. Also, I thought you quote in the paper was good!

Thank you.
Lori

From: Deb Yamamoto
To: Lori Cohen
Cc: Cami Grandinetti
Date: 01/24/2013 07:12 PM MST
Subject: Fw: PLEASE READ: FYI- LWG "feedback" concerning announcement of EPA comments on Draft FS

Wenona has some concerns with some of the things Alanna is offering below. She would like to talk next week. I think we should talk with her, and Mark Macintyre and Marianne Holsman all at the same time.

Deb Yamamoto, Manager
Site Cleanup Unit 2
Environmental Cleanup Office
U.S. Environmental Protection Agency
M/S ECL-115
1200 Sixth Avenue
Seattle, WA 98101
(206) 553-7216
----- Forwarded by Deb Yamamoto/R10/USEPA/US on 01/24/2013 06:11 PM -----

From: Wenona Wilson/R10/USEPA/US
To: Alanna Conley/R10/USEPA/US@EPA
Cc: Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Sean Sheldrake/R10/USEPA/US@EPA, Elizabeth Allen/R10/USEPA/US@EPA, Mark Macintyre/R10/USEPA/US@EPA
Date: 01/24/2013 05:49 PM
Subject: Re: PLEASE READ: FYI- LWG "feedback" concerning announcement of EPA comments on Draft FS

Hi Alanna - good summary and ideas for change. Let me talk with Deb first before we make any commitments of advance notice to the PRPs. Will get back to you soon -

Wenona Wilson, Manager
Community Engagement & Environmental Health Unit
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900 (ETPA-086)
Seattle, WA 98101-3140
Phone (206) 553-2148; Fax (206) 553-6984

From: Alanna Conley/R10/USEPA/US
To: Alanna Conley/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA, Sean Sheldrake/R10/USEPA/US@EPA, Elizabeth Allen/R10/USEPA/US@EPA, Mark Macintyre/R10/USEPA/US@EPA, Wenona Wilson/R10/USEPA/US@EPA,
Date: 01/24/2013 01:04 PM
Subject: PLEASE READ: FYI- LWG "feedback" concerning announcement of EPA comments on Draft FS

All, just wanted you to be aware of "feedback" received concerning the announcement delivered to the EPA Portland Harbor listserve re availably of EPA comments. Not sure if LWG has also contacted RA Office to provide "feedback".

LWG Concern:
1/23/13 Meeting with Barbara Smith (outreach contractor for LWG). Barbara expressed concern that LWG was not given prior notice of email announcing public of availability of EPA comments. Also concerned that in a December 2012 discussion with EPA, there was some agreement that EPA would not contact the media concerning the FS comments?? (she did not have specifics - I am not aware of this discussion)
Suggested communication solution:
Per discussion with Barbara, as a courtesy, EPA could notify LWG (Barbara) prior to announcing posting of documents, comments, reviews completed by LWG or EPA.
No commitment on timing for advanced notice was discussed but I could provide 1 or 2 day notification. Future discussion: LWG should expect that all public documents related to PH will be posted and announced by EPA, therefore it should not be a "surprise." This is a part of our community engagement activities.

Internal concern:

Deliberative Process / Ex. 5

Deliberative Process / Ex. 5

-----Forwarded by Alanna Conley/R10/USEPA/US on 01/24/2013 10:29AM -----
To: Alanna Conley/R10/USEPA/US@EPA
From: "U.S. Environmental Protection Agency" <usaepa@service.govdelivery.com>
Date: 01/22/2013 12:29PM
Subject: EPA comments on Draft Feasibility Study submitted by Lower Willamette Group

The Portland Harbor Superfund Site is the result of more than a century of industrial use along the Willamette River. Water and sediments along Portland Harbor are contaminated with many hazardous substances. Some of the compounds have been found to be harmful to human health and the environment. Because of the contamination, some types of fish found in Portland Harbor, such as bass, carp and catfish currently pose a health risk to those who eat them. EPA and the Oregon Department of Environmental Quality are working with potentially responsible parties to clean up contaminated sediment and control sources of additional contamination.
UPDATE
EPA received the draft feasibility study from the Lower Willamette Group in March 2012. The study describes various options for cleaning up Portland Harbor. EPA recently completed a technical review of the study and submitted comments to the Lower Willamette Group. Our comments are available for review (see below).
After revisions have been completed, EPA will write a Proposed Plan. The Proposed Plan will summarize the cleanup options and propose a preferred plan for cleaning up contaminated sediment in Portland Harbor. We anticipate having the Proposed Plan available in 2014.
In addition to comments on draft documents, EPA answers to community questions on proposed disposal facilities are available.
Stay informed - click documents below
EPA comments on the RI/FS Draft Baseline Ecological Risk Assessment - December 21, 2012
EPA comments on the March 2012 Draft Study Feasibility Study - December 18, 2012
Portland Harbor Baseline Human Health Risk Assessment Dispute Decision - December 6, 2012
Portland Harbor BHHRA Dispute Decision Memo - Partial Resolution - October 25, 2012
Proposed Confined Disposal Facility Questions and Answers - January 13, 2013
Learn more about Portland Harbor www.epa.gov/region10/portlandharbor
You are subscribed to EPA for Portland Harbor Updates. This information has recently been updated, and is now available.

Update your subscriptions, modify your password or email address, or stop subscriptions at any time on your Subscriber Preferences Page. You will need to use your email address to log in. If you have questions or problems with the subscription service, please contact support@govdelivery.com.
This service is provided to you at no charge by U.S. Environmental Protection Agency - Region 10.

This email was sent to conley.alanna@epamail.epa.gov using GovDelivery, on behalf of: U.S. EPA Pacific Northwest (Alaska, Idaho, Oregon, Washington) · 1200 Pennsylvania Avenue NW · Washington DC 20460 · 202-564-4355

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
Bcc: []
From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Thur 2/7/2013 3:00:04 AM
Subject: my comments on notes from Margaret Kirkpatrick

Hi Deb, here are some thoughts in blue... I don't have my notes here, but I cannot think of any missing topics.
I will be in Friday as well if we need to discuss any of this. Also, I like your idea of Dennis meeting with the Ed board when we have the next elected officials meeting.
Been a very interesting conference....
Lori

EPA/LWG Senior Managers Meeting
January 30, 2012
NW Natural
220 NW Second Avenue, Board Room
1:00—3:00 pm

Agenda

I. Process for finalizing LWG deliverables
a. EPA's proposed approach (Nov. 29, 2012)
b. LWG's suggested revisions (Jan. 16, 2013)
· We agreed to follow EPA's Nov. 29 Proposed Remedial Investigation Report revision process (with possible exceptions to the deadlines, noted below) for the next couple of months, then discuss whether it is working or needs some adjustment.
· We agreed that that the target dates set out in EPA's Nov. 29 proposal will change to conform to the common schedules for the RI and the FS that are now being developed.
· We did not discuss the LWG's proposal to extend the deadline for LWG initiation of a formal dispute from 14 days to 21 days after the conclusion of the last informal dispute resolution process. (LWG Senior Managers assume this will be resolved in the common schedule for the RI.)Deb - i think we just say that this would require an AOC change, instead, they can request the additional days if necessary and as I understand it, we have always granted this and I would be inclined to do so as well
· We discussed the LWG's proposal to extend the deadline for supplying a revised draft final RI Report, after EPA's comments on the individual chapters are resolved, from 30 to 60 days. EPA expressed a desire to receive the document before Dec. 24 and suggested a 45 day period. yes I agree this is how we left itWe did not resolve this question but anticipate that it will be resolved in the development of a common schedule for the RI.
c. Reconciliation of new process with Opalski decision in BHHRA Dispute
· Lori/Deb will discuss the LWG's concerns, as described in the LWG's January 17 2013 Memorandum from the LWG Legal Committee to the LWG Executive Committee, with Lori Cora. Lori Cora will work with Joan Snyder on a document that will reconcile EPA's Nov. 29 proposed process (as modified) with the language of the AOC and with the Final Resolution of the Dispute on the BHHRA. I talked with Lori C about drafting a letter to LWG with regard to clarifications to our Nov 29 proposal and she agreed to do so

II. External Communications
a. Oregonian article, January 23, 2013
· We agreed that articles like this—which emphasize conflicts between EPA and the LWG-- create unnecessary work for both EPA and the LWG.

· We agreed [at least I think we did but my notes are not clear] on a couple of ways to minimize the risk of similar articles (and headlines) in the future:

a. EPA "head's up" to the LWG when it plans to send information to the media, including when EPA plans to update its website with documents and send out notices to the listserve with those updates;

b. EPA and LWG will attempt to avoid language in written communications that can be quoted in the media to illustrate conflict. I think we said that we would work on the tone of EPA comment letters to communicate issues factually rather than inflammatory language. I don't think we can agree to all "written communications" because there may be times where a strongly worded letter is necessary.

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· Lori and Deb will get back to the LWG on its request to participate in the development of the CIP.I do not see any harm with Alana sharing the draft CIP and getting their comments - it does not mean we take them all. If requested, she can do the same with other parties. Do you have an issue with this? I also think that when she shares it, she should expressly ask for any plans they have for communications to the public as well.

III. Common Schedule

a. Risk Assessments

· LWG will submit the BHHRA electronically on Feb. 13 unless it receives additional comments from EPA. Additional comments will push the submission back to a later date.

· LWG will submit the BERA electronically to EPA on March 29.

· EPA will be able to complete it reviews of both documents within 14 days of LWG submission.

· Margaret will determine how long at it will take the LWG to publish the documents after EPA sign-off.

· This schedule will be discussed and resolved at the next Senior Manager meeting, to occur in March.

b. RI

· We discussed: (1) a Portland Harbor Project Schedule prepared by Kristine Koch that shows EPA submission of Section 10 "Edited tables, maps and Figures" and Section 11 "Edited text" to LWG on August 19, 2013; and (2) the LWG's Proposed Remedial Investigation Process document, dated Jan. 16, that shows resolution of Formal Dispute for RI issues and the end of November and submission of the Final RI to EPA 60 days later, at the end of January 2014.

· We agreed that Kristine will; (1) produce a revised draft schedule for the RI that assumes the August 19 date for providing Section 10 and 11 edits to the LWG and adds in the additional time periods described in EPA's Nov. 29 proposed process for LWG review, informal dispute, formal dispute of all remaining RI issues, and LWG production of the final RI document; and (2) provide that draft to Bob Wyatt for LWG review and comment.

· This schedule will be discussed and resolved at the next Senior Manager meeting to occur in March.

c. Feasibility Study

· We did not discuss a specific schedule for the FS.

· Lori and Deb reiterated EPA's desire to complete the FS in December of 2013.

· The next step is for the EPA and LWG project managers to decide whether the EPA or the LWG will take lead responsibility for specific tasks and subtasks necessary to complete the FS.

· EPA and LWG will identify specific individuals to take task and subtask lead responsibility.

· Development of a specific schedule will follow.Chip and Kristine met with J McKenna (and others?) today and had a good meeting re schedule and the BERA. He agreed to add the sentence (s) to respond to the Yakama's request to include something on tribal risk in the Exec Summ of the HHRA. I said I would give Margaret a heads up on this so they won't be surprised when we make that request, becuase they voted today on approval of the document and this is an "add on" after the process is pretty much completed - I will take ownership of this because I did not see it necc for the Yakama's to raise this to Dennis if we could resolve it with a sentence or two addition to a document....

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a. Spring meeting with elected officials

· We agreed that we would like to have, and describe to the elected officials, an agreed-upon process and common schedule for the production of all LWG deliverables under the AOC.

· Other topics would likely include:
a. Key finds of the BHHRA and BERA;
b. Range of options discussed in the FS.
· We agreed to schedule our next meeting in March so we will have time to come to agreement on process, schedule and other potential topics. Lori/Deb will provide potential dates.

From: Deb Yamamoto/R10/USEPA/US
To: Lori Cohen/R10/USEPA/US@EPA
Cc: Sean Sheldrake/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA
Date: 02/06/2013 04:01 PM
Subject: Call from Margaret Kirkpatrick

Lori,

I just got a call from Margaret. She was checking on a couple of things. First she wanted to make sure we got her notes from the meeting last week. I said yes, but you were out of town and I was waiting to get feedback from you before getting back to her. I'm hoping we can get back to her with our comments on Friday. Are you in? I have some comments that I can send you tomorrow.

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Sean, can you give us an update on what's happening?

Thanks,

Deb Yamamoto, Manager
Site Cleanup Unit 2
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1200 Sixth Avenue
Seattle, WA 98101
(206) 553-7216

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Lori Cohen/OU=R10/O=USEPA/C=US
Sent: Mon 2/11/2013 5:25:46 PM
Subject: Re: my comments on notes from Margaret Kirkpatrick

Hi-

you may hear that i am Personal Privacy / Ex. 6 today but i will take care of this by phone with Margaret. Safe travels!

Lori

From: Deb Yamamoto
To: Lori Cohen
Cc:
Date: 02/08/2013 03:03 PM MST
Subject: Re: my comments on notes from Margaret Kirkpatrick

See my comments in green, below.

Deb Yamamoto, Manager
Site Cleanup Unit 2
Environmental Cleanup Office
U.S. Environmental Protection Agency
M/S ECL-115
1200 Sixth Avenue
Seattle, WA 98101
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· We discussed the LWG's proposal to extend the deadline for supplying a revised draft final RI Report, after EPA's comments on the individual chapters are resolved, from 30 to 60 days. EPA expressed a desire to receive the document before Dec. 24 and suggested a 45 day period. yes I agree this is how we left itWe did not resolve this question but anticipate that it will be resolved in the development of a common schedule for the RI. I agree.

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· Other topics would likely include:

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To: Lori Cohen/R10/USEPA/US@EPA
Cc: Sean Sheldrake/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA

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Deb Yamamoto, Manager
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M/S ECL-115
1200 Sixth Avenue
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(206) 553-7216

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
Cc: CN=Cami Grandinetti/OU=R10/O=USEPA/C=US@EPA;CN=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Chip Humphrey/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]; N=Sheila Fleming/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Elizabeth Allen/OU=R10/O=USEPA/C=US
Sent: Thur 9/6/2012 1:06:51 AM
Subject: Re: Ummmmm, is this what we expected?
2012_8-30_BHHRA_Main_Text_clean with redline resolution EA_LWG comments.doc

No, it isn't what we asked them to do, which was provide proposed language. There are a lot of unresolved issues, and since the LWG is unable to make decisions, it doesn't give me great optimism for resolving much on Monday. OTOH, credit where credit is due, and appears they exercised quite a bit of restraint in the changes they have said they'd like to see. So that is a positive sign.

Elizabeth Allen
Office of Environmental Assessment
Risk Evaluation Unit
US Environmental Protection Agency, Region 10
1200 Sixth Ave, Suite 900
Seattle, WA 98101

206-553-1807
allen.elizabeth@epa.gov

-----Deb Yamamoto/R10/USEPA/US wrote: -----
To: Lori Cora/R10/USEPA/US@EPA
From: Deb Yamamoto/R10/USEPA/US
Date: 09/05/2012 05:19PM
Cc: Cami Grandinetti/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Elizabeth Allen/R10/USEPA/US@EPA, Kristine Koch/R10/USEPA/US@EPA
Subject: Re: Ummmmm, is this what we expected?

Apparently I wasn't on the distribution list because I don't have any messages from the LWG. Can you send me the documents you received?

Thanks,

Deb Yamamoto, Manager
Site Cleanup Unit 2
Environmental Cleanup Office
U.S. Environmental Protection Agency
M/S ECL-115
1200 Sixth Avenue
Seattle, WA 98101

(206) 553-7216

Lori Cora---09/05/2012 05:02:32 PM---If I understand, they left our changes highlighted and have used comment blocks where they have an i

From: Lori Cora/R10/USEPA/US
To: Kristine Koch/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, Elizabeth Allen/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Cami Grandinetti/R10/USEPA/US@EPA
Date: 09/05/2012 05:02 PM
Subject: Ummmmm, is this what we expected?

If I understand, they left our changes highlighted and have used comment blocks where they have an issue or otherwise noted where there is an unresolved issue, but no draft language on their part. Maybe its good they did not spend a lot of time rewriting per their RME proposal.

Lori Houck Cora | Assistant Regional Counsel
U.S. Environmental Protection Agency | Region 10
P: (206) 553.1115 | F: (206) 553.1762 | cora.lori@epa.gov

This message and its attachments may contain confidential and privileged attorney-client communication and/or attorney work-product. If you are not the intended recipient, you are not authorized to read, copy, distribute or in any way disclose the contents of this email or its attachments. If you have received this email in error, please notify the sender immediately and delete this email from your system.

PORTLAND HARBOR RI/FS

FINAL REMEDIAL INVESTIGATION REPORT

APPENDIX F

BASELINE HUMAN HEALTH RISK ASSESSMENT

FINAL

, 2012

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Attachment F3	Risks From Exposures to PBDEs
Attachment F4	ProUCL Software Output From the Calculation of 95 percent UCLs
Attachment F5	Supporting Documentation for the Calculation of Blood Lead Concentrations for Relevant BHHRA Scenarios
Attachment F6	Supporting Documentation for the Uncertainty and Variability Analysis

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LIST OF ACRONYMS

ACG	analytical concentration goal
ADAF	age-dependent adjustment factor
ALM	Adult Lead Methodology
AOPC	Area of Potential Concern
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BEHP	Bis 2-ethylhexyl phthalate
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
Cal EPA	California Environmental Protection Agency
CDC	Centers for Disease Control
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
cm/hr	centimeters per hour
CNS	central nervous system
COI	contaminant[1] of interest
COPC	contaminant1 of potential concern
CRITFC	Columbia River Inter-tribal Fish Commission
CSM	conceptual site model
CT	central tendency
DA_{event}	absorbed dose per event
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
delta-HCH	delta-hexachlorocyclohexane
DEQ	Oregon Department of Environmental Quality
DL	detection limit
DQO	data quality objective
E	east
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
EPD	effective predictive domain
FS	feasibility study
g/day	grams per day
GI	gastrointestinal
GSI	Groundwater Solutions, Inc.
HEAST	Health Effects Assessment Summary Table
HHRA	human health risk assessment

[1] Prior deliverables and some of the tables and figures attached to this document may use the teRM "Chemical of Interest" or "Chemical of Potential Concern", which as the same meaning as "Contaminant of Interest" or "Contaminant of Potential Concern", respectively, and refers to "contaminants" as defined in 42 USC 9601(33).

HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic model3
IRAF	Infant Risk Adjustment Factor
IRIS	Integrated Risk Information System
ISA	initial study area
K_p	dermal permeability coefficient
L/day	liters per day
LADI	lifetime average daily intake
LOAEL	lowest observed adverse effects level
LWG	Lower Willamette Group
LWR	Lower Willamette River
µg/dL	microgram per deciliter
µg/kg	microgram per kilogram
µg/L	microgram per liter
MCL	Maximum Contaminant Level
MCPP	2-(4-Chloro-2-methylphenoxy)propanoic acid
mg/kg	milligram per kilogram
ml/day	milliliters per day
ml/hr	milliliters per hour
MRL	method reporting limit
NHANES	National Health and Nutrition Evaluation Survey
NLM	National Library of Medicine
OAR	Oregon Administrative Rules
ODFW	Oregon Department of Fish and Wildlife
ODHS	Oregon Department of Human Services
pg/g	picograms per gram
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PEF	potency equivalency factor
PPRTV	Provisional Peer Reviewed Toxicity Value
PRG	preliminary remediation goal
RBC	risk-based concentration
RfD	reference dose
RG	remediation goal
RI/FS	remedial investigation/feasibility study
RM	river mile
RME	reasonable maximum exposure
RSL	Regional Screening Level
SCRA	site characterization and risk assessment
SF	slope factor
STSC	Superfund Health Risk Technical Support Center
SVOC	semi-volatile organic compound

TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalent
TZW	transition zone water
UCL	upper confidence limit
USDA	United States Department of Agriculture
VOC	volatile organic compound
W	west
WHO	World Health Organization
XAD	XAD-2 Infiltrex™ 300 system

GLOSSARY

Term	Definition
bioaccumulation	the accumulation of a substance in an organism
bioconcentration factor	the concentration of a chemical in the tissues of an organism divided by the concentration in water
central tendency	a measure of the middle or expected value of a dataset
contaminant of concern	the subset of contaminants[2] of potential concern with exposure concentrations that exceed EPA target risk levels
contaminant of interest	contaminant2 detected in the Study Area for all exposure media (i.e., surface water, transition zone water, sediment, and tissue)
contaminant of potential concern	the subset of contaminants2 of interest with maximum detected concentrations that are greater than screening levels
composite sample	an analytical sample created by mixing together two or more individual samples; tissue composite samples are composed of two or more individual organisms, and sediment composite samples are composed of two or more individual sediment grab samples
conceptual site model	a description of the links and relationships between chemical sources, routes of release or transport, exposure pathways, and the human receptors at a site
congener	a specific chemical within a group of structurally related chemicals (e.g., PCB congeners)
human health risk assessment	a process to evaluate the likelihood that adverse effects to human health might occur or are occurring as a result of exposure to one or more contaminants
dose	the quantity of a contaminant taken in or absorbed at any one time, expressed on a body weight-specific basis; units are generally expressed as mg/kg bw/day
empirical data	data quantified in a laboratory
exposure assessment	the part of a risk assessment that characterizes the chemical exposure of a receptor

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exposure pathway	physical route by which a contaminant moves from a source to a human receptor
exposure point	the location or circumstances in which a human receptor is assumed to contact a contaminant
exposure point concentration	the value that represents the estimated concentration of a contaminant at the exposure point
exposure area	size of the area through which a receptor might come in contact with a contaminant as determined by human uses
hazard quotient	the quotient of the exposure level of a chemical divided by the toxicity value based on noncarcinogenic effects (i.e., reference dose)
predicted data	data not quantified in a laboratory but estimated using a model
reasonable maximum exposure	the maximum exposure reasonably expected to occur in a population
receptor	The exposed individual relative to the exposure pathway considered
risk	the likelihood that a specific human receptor experiences a particular adverse effect from exposure to contaminants from a hazardous waste site; the severity of risk increases if the severity of the adverse effect increases or if the chance of the adverse effect occurring increases. Specifically for carcinogenic effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Specifically for noncarcinogenic (systemic) effects, risk is not expressed as a probability but rather is evaluated by comparing an exposure level over a period of time to a reference dose derived for a similar exposure period.
risk characterization	a part of the risk assessment process in which exposure and effects data are integrated in order to evaluate the likelihood of associated adverse effects
slope factor	toxicity value for evaluating the probability of an individual developing cancer from exposure to contaminant levels over a lifetime
Study Area	the portion of the Lower Willamette River that extends from River Mile 1.9 to River Mile 11.8

toxic equivalency factor	numerical values developed by the World Health Organization that quantify the toxicity of dioxin, furan, and dioxin-like PCB congeners relative to 2,3,7,8-tetrachlorodibenzodioxin
transition zone water	Pore water associated with the upper layer of the sediment column; may contain both groundwater and surface water
uncertainty	a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution
upper confidence limit on the mean	a high-end statistical measure of central tendency
variability	a component of risk resulting from true heterogeneity in exposure variables or responses, such as dose-response differences within a population or differences in contaminant levels in the environment

1.0 INTRODUCTION

This Baseline Human Health Risk Assessment (BHHRA) presents an evaluation of risks to human health at the Portland Harbor Superfund Site (Site) in Portland, Oregon. This BHHRA is intended to provide an analysis of baseline risks and help determine the need for action at the Site, and to provide risk managers with an understanding of the actual and potential risks to human health posed by the site and any uncertainties associated with the assessment.

Portland Harbor encompasses the Lower Willamette River (LWR) in Portland, Oregon, from the confluence with the Columbia to about River Mile (RM) 12. It has been the focus of numerous environmental investigations completed by the LWG and various other governmental and private entities. Major LWG data collection efforts occurred during four sampling rounds in the LWR from RM 0.8 to 12.2 to characterize the physical system of the river and to assess the nature and extent of contamination in sediment, surface water, transition zone water, storm water, and biota.

The LWG has worked with the United States Environmental Protection Agency (EPA) to develop the methods and assumptions used in this BHHRA. Consistent with EPA guidance (1989), this BHHRA incorporates assumptions to provide a health protective assessment of risks associated with contaminants present at the Site. The risk assessment for Portland Harbor is a baseline risk assessment in that it evaluates human health risks and hazards associated with contamination in the absence of remedial actions or institutional controls.

This BHHRA is being conducted as part of the Remedial Investigation Report (RI Report) to evaluate potential adverse health effects caused by hazardous substance releases at the Site, consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The BHHRA will be used to support the development of contaminant thresholds to be used as preliminary remediation goals (PRGs) for sediment. The PRGs will provide preliminary estimates of the long-terms goals to be achieved by any cleanup actions in Portland Harbor. During the feasibility study (FS) process, the PRGs will be refined based on background sediment quality, technical feasibility, and other risk management considerations. EPA will identify the final remediation goals (RGs) for the site in the Record of Decision, following completion of the FS.

1.1 OBJECTIVES

The general objective of a human health risk assessment in the CERCLA process is to provide an analysis of potential baseline risks to human health from site-related contaminants and help determine the need for remedial actions, provide a basis for determining contaminant concentrations that can remain onsite and still be protective of public health, and provide a basis for comparing the effectiveness of various remedial alternatives. To achieve the overall objectives, the general process of BHHRA is:

- Identify contaminants of potential concern (COPCs)[3]
- Identify potentially exposed populations and pathways of exposure to COPCs
- Characterize potentially exposed populations and estimate the extent of their exposure to COPCs
- Quantitatively characterize the noncarcinogenic and carcinogenic risks to the populations resulting from potential exposure to COPCs and identify contaminants potentially posing unacceptable risks
- Characterize uncertainties associated with this risk assessment
- Identify the contaminants and pathways that contribute the majority of the risk.

1.2 APPROACH

This BHHRA generally follows the approach that was documented in the Programmatic Work Plan (Integral et al. 2004) and subsequent interim deliverables. It also reflects numerous discussions and agreements on appropriate risk assessment techniques for the Site among interested parties, including the EPA, Oregon Department of Environmental Quality (DEQ), Oregon Department of Human Services (ODHS), and Native American Tribes.

Potential exposure pathways, populations, and exposure assumptions were originally identified in the Programmatic Work Plan and in subsequent direction from EPA. Additional assumptions for estimating the extent of exposure were provided in the Exposure Point Concentration Calculation Approach and Summary of Exposure Factors Technical Memorandum (Kennedy/Jenks Consultants 2006) and the Human Health Toxicity Values Interim Deliverable (Kennedy/Jenks Consultants 2004a). Specific documents related to the approach for this BHHRA are presented in Attachment F1. The BHHRA is based on EPA (1989, 1991b, 2001a, 2004, 2005a) and EPA Region 10 (2000a) guidance, and is also consistent with DEQ guidance (DEQ 2000a, 2010).

1.3 SITE BACKGROUND

The LWR extends from the Willamette's convergence with the Columbia River at river mile (RM) 0 upstream to the Willamette Falls at RM 26. Portland Harbor

[3] Prior deliverables and some of the tables and figures attached to this document may use the term "Chemicals of potential concern," which has the same meaning as "Contaminants of potential concern" and refers to "contaminants" as defined in 42 USC 9601(33).

generally refers to a heavily industrialized reach of the LWR between RM 0 and RM 12, the extent of the navigation channel. Additional information on the environmental setting of Portland Harbor, including historical and current land use, regional geology and hydrogeology, surface water hydrology, the in-water physical system, habitat, and human access and use is provided in Section 3 of the RI Report. The approximate 10-mile portion of Portland Harbor from RM 1.9 to 11.8 is referred to as the Study Area (Map 1-1). Because the Site boundaries have not yet been defined[4], this BHHRA focused on the Study Area, while also including data collected within the portion of the LWR that encompasses RMs 0.8 to 12.2.

Portland Harbor and the Willamette River have served as a major industrial water corridor for more than a century. Industrial use of the Study Area and adjacent areas has been extensive. The majority of the Study Area is currently zoned for industrial land use and is designated as an "Industrial Sanctuary" (City of Portland 2006a). Much of the shoreline in the Study Area includes steeply sloped banks covered with riprap or constructed bulkheads, with human-made structures such as piers and wharves over the water in various locations. A comprehensive update of Portland's Willamette Greenway Plan and related land use policies and zoning (The River Plan) is underway, addressing all of the Willamette riverfront in Portland (City of Portland 2006b). The Willamette Greenway Plan addresses the quality of the natural and human environment along the Willamette River and generally includes all land adjacent to the river, public lands near the river, and land necessary for conservation of significant riparian habitat. (The Willamette Greenway Plan, adopted by the City Council November 5, 1987, Ordinance 160237). The Greenway Plan is intended to "protect, conserve, enhance, and maintain the natural, scenic, historical, economic, and recreational qualities of lands along Portland's rivers." (Portland City Code Chapter 33.440). The Plan supports industrial uses within Portland Harbor while at the same time looks to increase public access to the river. As a result, recreational use within the Study Area may increase at certain locations in the future.

There are numerous potential human uses of Portland Harbor. Worker activities occur at the industrial and commercial facilities in the Study Area. However, due to the sparse beach areas and high docks associated with most of the facilities, worker exposure to the in-water portion of the Study Area may be limited in shoreline areas. Commercial diving activities also occur in the LWR. In addition, the LWR provides many natural areas and recreational opportunities, both within the river itself and along the riverbanks. Within the Study Area, Cathedral Park, located adjacent to the St. Johns Bridge, includes a sandy beach area and a public boat ramp and is used for water skiing, occasional swimming, and waterfront recreation. Recreational beach use also may occur within Willamette Cove, Swan Island Lagoon, and on the southern end of Sauvie Island. Swan Island Lagoon includes a public boat ramp. Additional LWR recreational beach areas exist on the northern end of Sauvie Island and in Kelley Point Park, both of which are outside of the Study Area.

[4] The Site boundaries will be defined by EPA in the Record of Decision for the Site.

Fishing is conducted throughout the LWR basin and within the Study Area, both by boaters and from locations along the banks. The LWR also provides a ceremonial and subsistence fishery for Pacific lamprey (particularly at Willamette Falls) and spring Chinook salmon for Native American Tribes. Many areas in the LWR are also important currently for cultural and spiritual uses by local Native Americans.

Transients have been observed along the LWR, including some locations within the Study Area. The observation of tents and makeshift dwellings during RI sampling events confirms that transients were living along some riverbank areas. Transients are expected to continue to utilize this area in the future.

The RI/FS being completed for the Site is designed to be an iterative process that addresses the relationships among the factors that may affect chemical distribution, risk estimates, and remedy selection. Four rounds of field investigations have been completed as part of the RI/FS. A preliminary sampling effort was conducted in 2001 and 2002 prior to the RI/FS work plan. Round 1 was conducted in 2002 and focused primarily on chemical concentrations in fish and shellfish tissue and in beach sediment. Round 2 was conducted in 2004 and 2005 and focused on chemical concentrations in sediment cores, in-water surface sediment, surface water, transition zone water, and additional shellfish tissue and beach sediment. Round 3 was conducted in 2006 and 2007 and focused on chemical concentrations in additional surface water, sediment, and fish and shellfish tissue. These Round 1, Round 2, and Round 3 sampling efforts, while initially focused on RM 3.5 to 9.2, which is the Administrative Order on Consent-defined initial study area (ISA), extended well beyond the ISA to RM 0 downstream and to RM 28.4 upstream.

1.4 ORGANIZATION

In accordance with guidance from EPA (1989), which is consistent with DEQ guidance (2000a, 2010), the BHHRA incorporates the four steps of the baseline risk assessment process: data collection and evaluation, exposure assessment, toxicity assessment, risk characterization, as well as a discussion of overall uncertainties.

This BHHRA is organized as follows:

- Section 2, Data Evaluation – This section evaluates the available data for the Study Area and identifies the COPCs for further evaluation in the BHHRA.
- Section 3, Exposure Assessment – This section presents potentially complete routes of exposure and potentially exposed populations for further evaluation in the BHHRA, which are summarized in the conceptual site model (CSM).
- Section 4, Toxicity Assessment – This section evaluates the potential hazard and toxicity of the COPCs selected for quantitative evaluation in this BHHRA.

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- Section 5, Risk Characterization – This section presents the cancer risks and noncancer hazards and identifies the contaminants potentially posing unacceptable risks to human health.
- Section 6, Uncertainty Analysis – This section discusses the uncertainties that are inherent in performing a HHRA, and the uncertainties specific to this BHHRA.
- Section 7, Summary – This section summarizes the findings of this BHHRA and identifies chemicals and pathways that contribute the majority of the risk within the Study Area.
- Section 8, Conclusions – This section provides the conclusions for this BHHRA.
- Section 9, References – This section lists the references used in this BHHRA.

2.0 DATA EVALUATION

This section presents the data that were used in this BHHRA and the results of the selection of COPCs in sediment, water, and tissue. The LWG and non-LWG sampling events included in the site characterization and risk assessment (SCRA) dataset are described in detail in Appendix A of the RI Report. The dataset used in this BHHRA represents a subset of data from the sampling events that comprised the SCRA dataset as of September 2008. Data needs for the BHHRA were identified through the data quality objective (DQO) process described in Section 7 of the Programmatic Work Plan (Integral et al. 2004). Only data that met Category 1/QA2 data quality objectives was used in the BHHRA. A risk evaluation of exposures to polybrominated diphenyl ethers (PBDEs) detected in in-water sediment, fish and shellfish tissue was conducted using a subset of data from the sampling events that comprised the SCRA dataset as of February 2011. The data for the PBDE analysis are discussed in Attachment F3, and the PBDE risk assessment used the general data evaluation methodology discussed in this section.

2.1 AVAILABLE DATA

The BHHRA dataset includes only those matrices relevant for direct human exposure pathways: surface sediment, clam and crayfish tissue, fish tissue, surface water and groundwater seeps. Other matrices included in the SCRA dataset (such as subsurface sediment) were not evaluated in the BHHRA because human exposure was considered unlikely. Data from RM 1.0, including Multnomah Channel, and upstream to RM 12.2, were included in the risk assessment. The BHHRA dataset is summarized by matrix in Table 2-1. The dataset is described briefly in the following subsections, and described in more detail in Section 2.0 of the RI Report.

2.1.1 Beach Sediment

Areas where potential exposure to beach sediment could occur were based only on current conditions, as identified in the Programmatic Work Plan. Because beaches are relatively dynamic environments, specific beach conditions may change in the future, and the evaluation presented in the BHHRA may no longer be appropriately descriptive of potential risks.

Composite sediment samples were collected during Round 1 from each beach that had been designated as a potential human use area within the Initial Study Area (ISA). Additional human use areas within the Study Area but downstream of the ISA were sampled during Round 2 as part of the sampling of shorebird habitat were also included in the BHHRA dataset. The designated potential human use areas and associated beach sediment samples are shown in Map 2-1, and Table 2-2 presents a summary of the composite sediment samples included in the BHHRA dataset.

2.1.2 In-Water Sediment

The in-water sediment BHHRA dataset includes samples collected outside of the navigation channel of the river and from less than 30.5 cm in depth. Beach sediment samples are excluded, as well as natural attenuation core samples, radioisotope samples, and samples collected from areas that were subsequently dredged. The in-water sediment dataset is comprised of samples collected within the study area includes samples from river mile (RM) 1 to RM 12.2, including Swan Island Lagoon, as well as samples from the mouth of Multnomah Channel. As described in Appendix A of the RI, samples collected from areas that have subsequently been capped or dredged were not included in the BHHRA dataset. Per an agreement with EPA, the screening of contaminants of potential concern (COPCs) used only the subset of data collected from RM 1.9 to RM 11.8 (and including Swan Island Lagoon and the mouth of Multnomah Channel), whereas the exposure assessment and risk characterization used both subsets of data containing samples from RM 1 to RM 12.2. A summary of in-water sediment samples included in the BHHRA dataset is presented in Table 2-3.

2.1.3 Surface Water

Surface water samples were collected by the LWG in seven separate events during Rounds 2 and 3 between 2004 and 2007, and are representative of various seasonal water flow conditions. Surface water samples were collected between RM 1.9 and RM 11.8 from 32 single point stations and 5 transect locations (at RM 2.0, Multnomah Channel, RM 3.9, RM 6.3, and RM 11). One additional surface water sample was collected from RM 16, outside the boundaries of the Study Area. Surface water samples were collected using either a peristaltic pump or an XAD-2 Infiltrex™ 300 system (XAD). Single point samples included near-bottom and near-surface samples, as well as vertically integrated water column samples. Transect samples included horizontally integrated near-bottom and near-surface samples, cross-sectional equal discharge increment samples horizontally integrated across the entire width of the river , and vertically integrated samples from the east, west, and middle sections of a transect on the river. Additional information on the surface water sampling methods is available in Section 5.3 of the RI Report. Tables 2-5 and 2-6 present a summary of the surface water samples included in the BHHRA dataset from within and outside of the Study Area, respectively.

2.1.4 Groundwater Seeps

A seep reconnaissance survey was conducted during Round 1 to document readily identifiable groundwater seeps along both sides of the river from RM 2 to 10.5 (GSI 2003). Twelve potential groundwater seeps were observed at or near potential human use beach areas. Of these, only three sites were identified in the survey where it was considered likely for upland contaminants of interest (COIs)[5] to reach groundwater seeps or other surface expressions of groundwater discharging to human use beaches: the City of Portland storm sewer Outfall 22B, Willbridge, and McCormick and Baxter at Willamette Cove. Of these locations, only the Outfall 22B discharge was evaluated in the BHHRA. Groundwater infiltrates into the outfall pipe, which subsequently discharges to a beach that has been identified as a potential transient use area. The groundwater seep at Willbridge is at a beach restricted to industrial use, the seep at Willamette Cove, located downgradient of the McCormick and Baxter Superfund Site, was capped during remedial activities in 2004.

The stormwater pipeline that discharges at Outfall 22B provides a conduit for surface discharge of groundwater containing COIs that infiltrates into the pipe upland of the beach. The sampling events at Outfall 22B are described in Appendix A of the RI Report. Although samples have periodically been collected for analysis of the discharge at Outfall 22B both during and outside of stormwater events, samples taken during stormwater events were not included in the BHHRA dataset because they were not considered representative of typical exposures. Samples collected since 2002 were used in the BHHRA, and Table 2-5 presents a summary of the samples that were included in the BHHRA dataset.

2.1.5 Fish Tissue

The target fish species to be evaluated for human consumption were identified in the Programmatic Work Plan (Integral et al. 2004), and consisted of both resident and non-resident species. Samples of resident fish species were collected by the LWG during Rounds 1 and 3. Samples of non-resident fish species were collected in the summer of 2003 through a cooperative effort of the ODHS, Agency for Toxic Substances and Disease Registry (ATSDR), Oregon Department of Fish and Wildlife (ODFW), the City of Portland and EPA Region 10. Table 2-7 presents a summary of the fish tissue samples included in the BHHRA dataset.

2.1.5.1 Resident Fish Tissue

Resident fish species evaluated in the BHHRA are smallmouth bass (*Micropterus dolomieui*), black crappie (*Pomoxis nigromaculatus)*, common carp (*Cyprinus carpio carpio)*, and brown bullhead (*Ameiurus nebulosus*). The sampling protocol for each species differed based on the reported home ranges of species sampled. The tissue compositing scheme for the Round 1 data collection effort was reviewed and approved by EPA in November and December 2002. The Round 3 data collection, the tissue compositing scheme was approved by EPA in October 2007. Smallmouth bass and carp collected during Round 3 were analyzed separately as fillet and the remaining body-without-fillet tissue, and whole body concentrations were calculated using the individual fillet and body-without-fillet results. Thus, for the risk

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assessment, the Round 3 smallmouth bass samples were reported both as fillet and whole body results.

Smallmouth bass samples were collected in Round 1 from eight locations between RM 2 and 9, and corresponding to their small home range (ODFW 2005), and composited based on each river mile. Three whole body replicate composite samples were collected at three of the eight locations, one whole body composite sample and one fillet composite sample were collected at the 5 remaining sample locations. Round 3 samples were collected from 18 stations between RM 2 and 12, each corresponding to approximately one river mile, either the west or east side of the river, or both. One composite sample was collected from each station, typically consisting of five individual fish.

Black crappie, common carp, and brown bullhead samples were collected during Round 1 and composited from two three-mile long fishing zones, RM 3-6 and RM 6-9. Three common carp and brown bullhead whole body and fillet replicate composite samples were collected from each zone. Two black crappie whole body and fillet replicate composite samples were collected within each zone. All results from within the Study Area were included in the BHHRA dataset.

During Round 3, common carp samples were collected from three fishing zones, each approximately four river miles in length (RM 0-4, RM 4-8, and RM 8-12). Three common carp composite samples were collected from each fishing zone and analyzed separately as fillet tissue and body-without-fillet tissue. All Round 3 results were included in the BHHRA dataset.

Smallmouth bass, black crappie, and common carp fillet samples were analyzed as fillet with skin, except for the analysis of mercury, which was performed using fillet without skin. Brown bullhead fillet samples were analyzed as fillet without skin.

2.1.5.2 Salmon, Lamprey, and Sturgeon

Adult white sturgeon (*Acipenser transmontanus*), adult spring Chinook salmon (*Oncorhynchus tshawytscha*), and adult Pacific lamprey (*Lampetra tridentate*) were collected during ODHS Study. Although these data were not collected as part of the RI, the data met Category 1/QA2 data quality requirement s and were evaluated by the LWG and used in this BHHRA.

Adult Chinook salmon samples were collected at the Clackamas fish hatchery. Each composite sample consisted of three individual fish. Five whole-body (including one split), three fillet with skin, and three fillet without skin composite samples were analyzed. The fillet without skin composite samples were only analyzed for dioxin, furan, and polychlorinated biphenyl (PCB) congeners and mercury.

Adult Pacific lamprey samples were collected at the Willamette Falls. Four whole body composite samples, each consisting of 30 individual fish, were analyzed.

Adult sturgeon samples were collected between RM 3.5 and 9.2. Six fillet samples were analyzed without skin (including one split), each sample consisting of a single fish.

2.1.6 Shellfish Tissue

Crayfish samples were collected from 24 stations during Round 1 based on habitat areas and from 9 stations during Round 3 based on habitat areas and data needs identified by the EPA. Commensurate with their limited home range, crayfish were collected and analyzed as whole body composite samples from each individual station. During Round 1, two replicate composite samples were collected at three of the 24 stations; a single composite sample was collected at the remaining stations. During Round 3, a single composite sample was collected at each station.

Clams (*Corbicula* sp.) were collected from three stations during Round 1, 33 stations during Round 2, and 10 stations during Round 3, sampling locations were based on habitat areas and biomass availability. A single composite sample was collected at each station in Rounds 1 and 2. In Round 3, two composite samples were collected from each of five stations, and a single composite sample was collected from each of the remaining five stations. Round 1 and Round 2 samples were analyzed undepurated. As previously noted, two samples were collected from five of the sampling stations in Round 3, one sample from each station was depurated prior to analysis, the other was analyzed undepurated. At the remaining stations, only undepurated samples were analyzed. Depuration is a common method for cleansing shellfish that is often done prior to their consumption by humans to eliminate the sediment present in the gastrointestinal tract of the shellfish. Although data from laboratory bioaccumulation samples were also available from Round 2, these data were not used because field-collected tissue samples provide for a more direct evaluation of potential human exposure than laboratory bioaccumulation samples. Tables 2-7 and 2-8 present a summary of the shellfish tissue samples included in the BHHRA dataset, from both inside and outside the Study Area, respectively.

2.2 DATA EVALUATION

Prior to using the data in the BHHRA, the data were evaluated for inclusion in the BHHRA consistent with the Guidelines for Data Reporting, Data Averaging, and Treatment of Non-Detected Values for the Round 1 Database (Kennedy/Jenks Consultants et al. 2004), the Exposure Point Concentration Calculation Approach and Summary of Exposure Factors (Kennedy/Jenks Consultants 2006), and Proposed Data Use Rules and Data Integration for Baseline Human Health Risk Assessment (BHHRA), submitted to EPA in a May 28, 2008 email. Data use rules applied to the combining of surface water data collected by different methods, the handling of non-detects, the summing of chemical groups, and the calculation of exposure point concentrations (EPCs).

2.2.1 Excluded Data

The data used BHHRA meet Category 1/QA2 data quality objectives, as described in Section 2.2 of the RI Report. Data that were not of this quality were removed from the BHHRA dataset. General reductions of the SCRA dataset to create the BHHRA dataset included removal of rejected analytical results ("R" qualified results), and removal of analytical results of samples collected from locations that have been capped, dredged, or remediated. This included all samples flagged as capped, dredged or remediated, including data from task WLCMBI02: the McCormick & Baxter September 2002 Sampling.

2.2.2 Field Replicates

Field replicates within the BHHRA dataset were handled per agreements with EPA. When calculating a mean or an upper confidence limit (UCL), and when reporting data in general, replicates were included in the dataset as discrete samples. Replicates with unique coordinates were included as separate samples when mapping or spatially weighing data. Where replicates have the same coordinates, data associated with the first sample were used and data from the second or third replicates were excluded.

2.2.3 Co-elution of PAHs

Benzo(b+k)fluoranthenes and benzo(k+j)fluoranthenes co-eluted in certain surface water and in-water sediment samples. For the purposes of the BHHRA, benzo(b+k)fluoranthenes results were assumed to be completely benzo(b)fluoranthene, and benzo(k+j)fluoranthenes results were assumed to be completely benzo(k)fluoranthene. Analytical results for these samples were not presented as co-elutions in the BHHRA, but rather, were presented as results for their assumed analyte.

2.2.4 Treatment of PCB Surface Water Data

Polychlorinated biphenyls (PCBs) were analyzed as Aroclors in samples collected using a peristaltic pump, and as congeners in high-volume samples collected using the XAD-2 sampling method. Because detection limits for the peristaltic pump samples were higher than those using high-volume samples, the results for PCBs from the high-volume samples were used. Aroclor concentrations in the high-volume samples were estimated from the PCB congener data by the analytical laboratory. Therefore, Aroclor data were not used, and only PCB congener data were used to assess PCBs in the BHHRA surface water dataset.

2.2.5 Combining XAD Column and Filtered Surface Water Data

The XAD water quality samples consisted of two components: chemicals retained on the column that are representative of the dissolved concentration, and chemicals retained on the filter that are representative of the concentration of the suspended particulate fraction. In order to create a whole water sample from the XAD results, the analytical results for column and filter fractions for a given chemical were combined to give a total concentration. The following rules were used to calculate a whole water concentration for individual samples:

- If an analyte was detected in both the filter and the column, the detected concentrations were summed.
- If an analyte was detected in either the filter or the column but not in both portions of the sample, only the detected concentration was used.
- If an analyte was not detected in both the filter and the column, the highest detection limit reported for either the filter or the column was used.

Surface water samples collected using the high-volume XAD-2 sampling method are identified with the letters "XAD." The results of the combined XAD-2 column and filter data were renamed "WSXAD-Combo," and are presented as such in the BHHRA.

2.2.6 Combining Horizontal and Vertical Surface Water Data

The surface water data described in Section 2.1.3 were vertically integrated prior to use in the BHHRA. Transect samples are presented as a vertically and horizontally integrated transect. Non-integrated samples were collected from both near-bottom and near-surface (NB/NS) depths within the water column at single-point sampling locations. Vertically-integrated transect samples were collected from the east, west, and middle (E/W/M) sections of the river, horizontally integrated samples were collected from NB or NS water depths. NB/NS and/or E/W/M samples from the same location and date were combined to provide an integrated value for the water column or transect. In these cases, single-point data from NB and NS were vertically combined, vertically-integrated data from E/W/M were horizontally combined; and horizontally-integrated data from NB/NS were vertically combined using the following rules:

- If an analyte was detected in each sample, the detected concentrations were averaged.
- If an analyte was detected in at least one sample, the mean concentration was calculated using one-half the detection limit for non-detect results.
- If all results were non-detect, the mean of the detection limits was calculated and used as the non-detected concentration ("U" qualified).

- In some instances, a field replicate sample was collected from the middle of the river without corresponding replicate samples from the east or west side of the river, indicated by "M2" in the Sample ID. The results from these samples were included in the dataset at their reported concentrations, without combining them with other results.

Sample IDs for the results of the horizontally or vertically combined integrated data were renamed to include "-Int" at the end of the ID name, and are presented as such in the BHHRA.

2.2.7 Combining Fillet and Body-Without-Fillet Tissue Data

Smallmouth bass and carp samples collected during the LWG Round 3 sampling event were analyzed separately as fillet and body-without-fillet tissue. The results of these analyses were combined on a weighted-average basis to provide whole body results for use in the BHHRA. The steps used in combining the data were as follows:

- The whole-body tissue mass was calculated for each individual fish within each composite by summing its fillet and body-without-fillet tissue mass.
- The ratio of fillet to whole-body tissue mass was calculated for each individual fish within each composite. Likewise, the ratio of body-without-fillet to whole-body tissue mass was calculated for each individual fish within each composite.
- For each composite, the average of the fillet to whole-body tissue mass ratios was calculated, and the average of body-without-fillet to whole-body tissue mass ratios was calculated to provide an average of the percentage of fillet and body-without-fillet tissue mass for each composite.

The average percentages were then used to calculate a weighted average concentration for each composite sample according to the following rules:

- If the analyte was detected in both the fillet tissue and the body without fillet tissue, a weighted average was calculated using the detected values
- If the analyte was not detected in either of the tissue types, a weighted average was calculated using the full detection limits
- If the analyte was detected either the fillet or body-without-fillet sample, one-half the detection limit for the non-detect result was used to calculate the weighted average.

The combined fillet and body without fillet tissue data were considered whole body tissue results for carp and smallmouth bass and were used in the BHHRA as such.

2.2.8 Summation Rules for Analytes Evaluated as Summed Values

Certain contaminants were evaluated as the sum of similar individual congeners, isomers, and closely related degradation products of the parent compound rather than as individual chemicals. The chemicals evaluated as mixtures and for which analytes evaluated as sums in the BHHRA are as follows:

- Total PCBs were calculated as either the sum of nine Aroclor mixtures (1016, 1221,1232, 1242, 1248, 1254, 1260, 1262, 1268) or the sum of individual PCB congeners.
- Total endosulfan was calculated as the sum of α-endosulfan, β-endosulfan, and endosulfan sulfate.
- Total chlordane was calculated as the sum of *cis*- and *trans*-chlordane, oxychlordane, and *cis*- and *trans*-nonachlor.
- Total DDD was calculated as the sum of 2,4'-DDD and 4,4'-DDD.
- Total DDE was calculated as the sum of 2,4'-DDE and 4,4'-DDE
- Total DDT was calculated as the sum of 2,4'-DDT and 4,4'-DDT
- Total dioxin-like PCB congeners were calculated as the sum of PCBs 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, and 189.
- Total PCBs-adjusted were calculated as the sum of total PCB congeners minus dioxin-like PCB congeners.
- Total xylenes were calculated as the sum of *m*-, *o*-, and *p*-xylene.

The individual components of each chemical mixture used in the BHHRA are presented in Table F2-2.

If an individual analyte of a chemical mixture was detected at least once within the study area in a given medium, it was considered present in that medium. The presence of an analyte in biota samples was assessed separately for each individual species and tissue. The presence of individual analytes in sediment, and surface water were also assessed separately based on the specific exposure scenario. Individual analytes that were a part of a chemical mixture but were determined not to be present are summarized in Table F2-3 by medium and species. Additionally, a minimum number of individual analytical results in the mixture was required for the summed analytical result to be calculated. For example, if a sample was only analyzed for a limited number of individual PCB congeners, or if a large number of individual congener results for a sample were rejected, a total PCB congener sum may not have been calculated. In addition, chemical mixtures for samples meeting the criterion for the minimum number of individual analytical results required to calculate a sum, but with a limited number of individual analytical results, were qualified with an "A." Mixture sums that did not have a limited number of individual analytical results were qualified with a

"T," indicating a calculated total. Table F2-4 shows the minimum number of individual analytical results required to calculate a sum for each mixture, and the maximum number of individual analytical results that would result in an "A" qualifier, indicating a limited number of individual analytical results were available for a sample. Table F2-4 also lists the number of samples for each medium for which a summed total was calculated, and the number of samples for which a summed total was not calculated because of lack of individual analytical results for the mixture. Sample IDs of samples for which a summed analytical result was not calculated are presented in Table F2-5.

Concentrations of the individual analytes that comprise a mixture were summed for each sample according to the following rules:

- If an analyte was detected in the sample, the detected concentration was used to calculate the sum
- If an analyte was not detected in a sample but was assumed to be present in the sample medium, one-half the detection limit was used to calculate the sum
- If all results were non-detect, the highest detection limit of the analytes assumed to be present in the medium was used as the detection limit for the sample, and the sample was flagged as a non-detect.

2.2.9 Total Dioxin/Furan and PCB TEQs

A toxicity equivalence procedure was used to assess the cumulative toxicity of complex mixtures of PCDD, PCDF, and PCB congeners. The procedure involves assigning individual toxicity equivalency factors (TEF's) to the PCDD, PCDF, and PCB congeners in terms of their relative toxicity to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). The reported concentration of each congener in a sample is multiplied by its respective TEF to give the TEF-equivalent concentration. The resulting concentrations are then summed to give a TEQ. The World Health Organization (WHO) TEFs (Van den Berg et al. 2006), shown in Table 4-3, were used to calculate the total dioxin/furan and PCB TEQs. Dioxin/furan and PCB-TEQs were calculated according to the following rules

- Congeners reported as not detected in a given sample but determined to be present in the medium, one-half the detection limit multiplied by the TEF was used in the sum
- If all results in a sample were non-detect, the maximum toxicity-weighted detection limit was used for the TEQ, and the result was flagged as non-detect (U-qualified). The maximum toxicity-weighted detection limit was obtained by multiplying each detection limit by its respective TEF and selecting the maximum value.

- Dioxin/furan TEQs were not calculated for those samples where analytical results for all 12 dioxin/furan congeners were not available.

Values were not presented for total TEQ in the BHHRA. Rather, risks from total TEQ were estimated by summing the risks from the total PCB TEQ and the total dioxin/furan TEQ.

2.3 CHEMICAL SCREENING CRITERIA AND SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

Because of the large number of chemicals detected in environmental media, a risk-based screening approach was used to focus the risk assessment on those contaminants most likely to significantly contribute to the overall risk. COPCs were selected for quantitative evaluation in the BHHRA by comparing the SCRA analytical data to risk-based screening values. The specific risk-based concentrations used to select COPCs are described below for the each media.

2.3.1 Sediment

EPA's Regional Screening Levels (RSLs) for soil (EPA 2010a) were used as the screening values for beach and in-water sediments. RSLs are risk-based concentrations in soil, air and water, and have been developed for both residential and industrial exposure scenarios. Using default exposure assumptions, RSLs represent concentrations that equate to a target cancer risk of 1 x 10^{-6} or a hazard quotient of 1. As described in Region 10 guidance (2007a), RSLs based on a noncancer endpoint were divided by 10 to give a value equivalent to using a hazard quotient of 0.1. This was done to account for the additive nature of noncancer effects. RSLs based on noncancer endpoints were divided by 10 to account for potential cumulative effects from multiple chemicals, and these modified RSLs were used as the screening values. Consistent with the then current EPA Region 10 recommendations (EPA, 2008), a RSL of 7.7 mg/kg in soil for residential land use was calculated for trichloroethylene (TCE) using a cancer slope factor of 0.089 per mg/kg-day, which represents the geometric mid-point of the slope factor range from EPA 2001. EPA finalized its risk assessment for TCE in 2011 and the revised RSL is 0.9 mg/kg. Because TCE does not contribute substantially to the cumulative risk estimates for the in-water portion of Portland Harbor, the screening process was not re-evaluated. Chemicals for which no RSL was available were screened using RSLs for chemicals with a similar chemical structure.

Because uses of Portland Harbor include both recreational and industrial activities, COPCs were selected using both residential and industrial RSLs, consistent with the EPA comments on the Round 2 Comprehensive Report (EPA 2008b). Residential RSLs were used to select COPCs in beach sediment for those areas where exposures could occur during recreational, transient, or fishing activities in those areas considered reasonably accessible from contiguous upland areas or by boat. In-water sediment data collected within the navigation channel were not used in the COPC screen. In areas where occupational exposures could occur, and for in-water sediment, COPCs were selected using industrial RSLs.

If the maximum detected concentration of a contaminant at a specific use area was greater than its respective screening level, that contaminant was selected as a COPC. The designated potential uses for beaches in the Study Area are presented in Map 2-1. COPCs for beach sediment and the rationale for selection are presented in Tables 2-9 and 2-10. COPCs for in-water sediment are presented in Table 2-11.

2.3.2 Surface Water

EPA residential tapwater RSLs (EPA 2010a) and MCLs (EPA 2003a) were used as screening values for surface water and the groundwater seep to select COPCs for direct exposure scenarios. TCE was evaluated using the EPA Region 6 Human Health Medium-Specific Screening Level (EPA 2008a).

COPCs were selected separately for divers, transient/beach user exposures, and the potential use of surface water as a drinking water source. COPCs for evaluating exposure to divers and for drinking water were selected from the combined surface water data set described in Section 2.2.6. COPCs for transient and beach use scenarios were selected from surface water samples taken from areas where direct contact could occur. A summary of samples used for screening surface water for COPCs is provided in Table 2-12. Sample locations of surface water data evaluated and COPCs for diver exposures are shown on Map 2-3 and in Table 2-13; sample locations and COPCs for transient and recreational beach uses are shown on Map 2-4 and Table 2-14; sample locations and COPCs for the use of surface water as a drinking water source are shown on Map 2-8 and in Table 2-16.

2.3.3 Groundwater Seep

Chemicals concentrations detected in the groundwater seep at Outfall 22B were compared to the residential tapwater RSLs. As with the soil RSLs, the tapwater RSLs based on a noncancer endpoint were divided by 10 to give values equivalent to a HQ of 0.1. The location of Outfall 22B is shown on Map 2-5, and COPCs are presented in Table 2-15.

2.3.4 Fish and Shellfish Tissue

No appropriate risk-based screening values for fish tissue were available. Although EPA Region 3 has published fish tissue screening levels, the consumption rate of 54 g/day used to derive those values is not considered representative of the range of consumption rates relevant to Portland Harbor. Accordingly, all chemicals detected in fish and shellfish tissue in the BHHRA dataset were considered to be COPCs and evaluated further in the BHHRA. The general locations of fish in a particular composite of smallmouth bass and common carp are shown on Map 2-6. Brown bullhead and black crappie were composited over RM 3-6 and RM 6-9. Shellfish were composited over areas representing their assumed home range, and sample locations on Map 2-7 represent the general spatial distribution of composited samples.

3.0 EXPOSURE ASSESSMENT

Exposure assessment is the determination of the magnitude, frequency, duration, and route of exposure (EPA, 1989). Populations that currently, or may in the future, come into contact with site contaminants are identified along with potential routes of exposure that define the mechanism by which the exposure may occur. Magnitude is determined by estimating the amount, or concentration, of the chemical at the point of contact over an exposure duration, as well as the actual intake, or dose, of the chemical.

According to EPA (1989), an exposure assessment includes three primary tasks:

- Characterization of the exposure setting. This step includes identifying the characteristics of populations that can influence their potential for exposure, including their location and activity patterns, current and future land use considerations, and the possible presence of any sensitive subpopulations.
- Identification of exposure pathways. Exposure pathways are identified for each population by which they may be exposed to chemicals originating from the site.
- Quantification of exposure. The magnitude, frequency, and duration of exposure for each pathway is determined. This step consists of the estimating of exposure point concentrations and calculation of chemical intakes.

3.3.1 Conceptual Site Model

The conceptual site model (CSM) describes potential contaminant sources, transport mechanisms, potentially exposed populations, exposures pathways and routes of exposure. As discussed in Sections 4, 5, and 6 of the RI Report, contaminated media within the Study Area are sediment, water, and biota. Current and historical industrial activities and processes within the Study Area have led to chemical releases from either point or nonpoint sources, including discharges to the river from direct releases or via outfalls and groundwater within the Study Area. In addition, releases that occur upstream of the Study Area and atmospheric deposition from global, regional, and local emissions may also represent potential contaminant sources to the Study Area. Chemicals in sediment and water may be accumulated by organisms living in the water column or by benthic organisms in sediments. Fish and shellfish within the Study Area feeding on these organisms can accumulate chemicals in their tissues through dietary and direct exposure to sediment and water. Additional information on potential contaminant sources is provided in Section 4 of the RI Report, and a more detailed CSM is presented in Section 10. A graphical representation of the exposure CSM is presented on Figure 3-1.

3.4 IDENTIFICATION OF POTENTIALLY EXPOSED HUMAN POPULATIONS

Potentially exposed populations were identified based on consideration of current and potential future uses of the Study Area. An analysis of potential exposure pathways for the Study Area is detailed in the Portland Harbor RI/FS Programmatic Work Plan (Integral 2004). The exposure scenarios identified below represent those populations that are anticipated to have the greatest potential for exposure to contaminants within the Study Area for both current and potential future conditions. For this reason, this risk assessment is likely to be protective of other potentially exposed populations that are not evaluated quantitatively in this BHHRA. The receptors evaluated for current and future uses of the Study Area are:

- Dockside workers
- In-water workers
- Transients
- Divers
- Recreational beach users
- Recreational/Subsistence Fishers
- Tribal fishers
- Domestic water users

The above populations were identified based on human activities know to occur within the Study Area, with the exception the use of surface water as a domestic water source. However, public and private use of surface water is a beneficial use of the LWR, and as described in Section 1, this baseline risk assessment evaluates exposures assuming no institutional controls, such as obtaining a permit for use of surface water. Each of these receptors is described in greater detail in the following sections.

3.4.1.1 Dockside Workers

Portland Harbor supports a large number of water-dependent commercial uses, and many of the facilities adjacent to the LWR rely on ship and barge traffic. Dockside workers were evaluated to be representative of industrial and commercial workers at many of the facilities adjacent to the river. Specific activities are assumed to occur only within natural river beach areas, and include unloading ships or barges, or conducting occasional maintenance activities at specific locations near or at the water's edge. Exposures for dockside workers are evaluated as occurring only within defined areas considered to be industrial sites, rather than on a Study Area or harbor-wide basis. The specific areas evaluated are shown on Map 2-1.

3.4.1.2 In-Water Workers

In-water workers were evaluated as representative of individuals who conduct activities that typically occur in or over-water, rather than on shore as assumed for dockside workers. Specific activities may include the repair of in-water structures such as docks or pilings, maintenance dredging of private slips or berths, or maintenance and cleaning of equipment. While such activities would not necessarily be restricted to a given area, exposure would most likely be localized to specific facilities, and between the shore and the navigation channel.

3.4.1.3 Divers

Several different groups of people dive in the Portland Harbor area, including the public for recreation (which may include gathering of biota for consumption), the sheriff's office for investigations and emergency activities, and commercial divers for a variety of purposes including marine construction, underwater inspections, routine operation and maintenance, and activities related to environmental work. The majority of divers are expected to be commercial divers who typically use either wet or dry suits, wet or dry gloves, and a full face mask or a regulator held in the mouth with the diver's teeth. Although dry suits provide greater protection, wetsuits are occasionallyused because of the higher cost of dry suits and higher water temperature (Sheldrake et. al, 2009). The Willamette River is 303d listed as a temperature impacted area, with the Lower Willamette reaching average temperatures of over 70 degrees F in the summer months. Based on communications with commercial diving companies in the Portland area (Hutton 2008, Johns 2008, and Burch 2008), the standard of practice for commercial divers is the use of dry suits and helmets when diving in the LWR. However, the use of wet suits is apparently still common among many commercial divers (EPA 2008c). Accordingly, two different diver exposure scenarios are included in this BHHRA, and are differentiated by considering the use of either a wet suit or dry suit. Each scenario assumes that divers are exposed to sediment and surface water through inadvertent ingestion and dermal contact throughout the Study Area.

3.4.1.4 Transients

Transient encampments are known to exist within the Study Area along the Lower Willamette River. While tents and makeshift dwellings are typically observed above actual beach areas, transients are likely to have direct contact with beach sediment and surface water (including groundwater seeps) during swimming, bathing or other activities, such as washing of clothing or equipment, and may also use surface water as a drinking water source. Although individuals are anticipated to move within or outside the Study Area, some individuals may spend a majority of their time at relatively few areas. Thus, exposure was evaluated as occurring at individual beaches rather than averaged over a larger area. Specific locations where exposure by transients was evaluated in the risk assessment are shown on Map 2-1.

3.4.1.5 Recreational Beach Users

Adults and children participate in recreational activities at beaches within the Study Area, and the LWR is also used for boating, water skiing, swimming, and other activities. The areas currently used for recreational activities as well as other areas in the Study Area where sporadic beach use may occur were identified as recreational use areas. While certain individuals may frequent a specific area almost exclusively, others users may regularly use various areas throughout the Study Area. Recreational activities are likely to result in exposure to beach sediment and surface water.

3.4.1.6 Recreational and Subsistence Fishers

A year-round recreational fishery exists within the Study Area. Current information indicates that spring Chinook salmon, steelhead, Coho salmon, shad, crappie, bass, and white sturgeon are the fish species preferred by local recreational fishers (DEQ 2000b, Hartman 2002, and Steele 2002). In addition to recreational fishing, an investigation by the Oregonian newspaper and limited surveys conducted on other portions of the Willamette River indicate that immigrants from Eastern Europe and Asia, African-Americans, and Hispanics are most likely to use fish from the lower Willamette either as a supplemental or primary dietary source (ATSDR 2002). These surveys also indicate that the most commonly consumed species are carp, bullhead catfish, and smallmouth bass, although other species may also be consumed. In conversations that were conducted as part of a project by the Linnton Community Center (Wagner 2004) about consumption of fish or shellfish from the Willamette River, transients reported consuming a large variety of fish, and several said they ate whatever they could catch themselves or obtain from other fishers.

Direct exposures to beach sediments by individuals engaged in recreational or subsistence fishing was evaluated at specific areas designated as transient and recreational use areas, exposures to in-water sediments were evaluated per half mile along each side of the river as well as on a Study Area-wide basis. Fish consumption was evaluated assuming a single-species diet comprised of each individual target resident fish species (smallmouth bass, black crappie, brown bullhead, and common carp), and based on whether only fillets or the whole fish is consumed. Exposure was evaluated over fishing zones, based on the relative size of the home range for each species, as well as averaged over the entire Study Area. In addition to the individual species diet, a multiple species diet was also evaluated on a harbor-wide basis, assuming each of the four target species comprised equal portions of the total fish consumption. In order to account for a range of cultural consumption practices, both fillet-only and whole body fish consumption were evaluated.

3.4.1.7 Tribal Fishers

The LWR provides a ceremonial and subsistence fishery for Native American tribes. Four Native American tribes (Yakama, Umatilla, Nez Perce, and Warm Springs) participated in a fish consumption survey that was conducted on the reservations of the participating tribes and completed in 1994 [Columbia River Inter-tribal Fish Commission (CRITFC) 1994]. The results of the survey show that tribal members surveyed generally consume more fish than the general public. Certain species, especially salmon and Pacific lamprey, are an important food source as well as an integral part of the tribes' cultural, economic, and spiritual heritage.

3.4.1.8 Domestic Water User

Although there are currently no known uses of the Lower Willamette River as a source of drinking water, public and private use of the Willamette River as a domestic water source is a designated beneficial use by the State of Oregon. Hence, use of surface water as a source of household water was assessed as a potentially complete pathway. Exposure to surface water could occur via ingestion and dermal contact, as well as volatilization of chemicals to indoor air through household use.

3.5 IDENTIFICATION OF EXPOSURE PATHWAYS

Exposure pathways are defined as the physical ways in which chemicals may enter the human body. A complete exposure pathway consists of the following four elements:

- A source of chemical release
- A release or transport mechanism (or media in cases involving media transfer)
- An exposure point (a point of potential human contact with the contaminated exposure medium)
- An exposure route (e.g., ingestion, dermal contact) at the exposure point.

If any of the above elements is missing, the pathway is considered incomplete and exposure does not occur. The potential exposure pathways to human populations at the Study Area include:

- Incidental ingestion of and dermal contact with beach sediment
- Incidental ingestion and dermal contact with in-water sediment
- Incidental ingestion and dermal contact with surface water
- Incidental ingestion and dermal contact with surface water from seeps
- Consumption of fish and shellfish
- Infant consumption of human milk.

A more detailed discussion of potential exposures for the Study Area under current and future conditions, and presents the rationale for including or eliminating pathways from quantitative evaluation. The identified receptors, exposure routes, and exposure pathways, and the rationale for selection are also summarized in Table 3-1.

Exposure pathways are designated in one of the following four ways:

Potentially Complete: There is a source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur. Pathways considered potentially complete are quantitatively evaluated in this BHHRA.

Potentially Complete but Insignificant: There is a source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur. However, exposure via the pathway is likely to be negligible relative to the overall risk. Pathways considered potentially complete but insignificant were not evaluated further in this BHHRA.

Incomplete: There is no source or release from a source, no exposure point where contact can occur, or no exposure route by which contact can occur for the given receptor. Pathways considered potentially incomplete were not evaluated further in this BHHRA.

Potentially complete pathway, but evaluated for a different receptor: These pathways may be complete for some individuals, but are not evaluated for the identified receptor because the pathways are not considered typical for that receptor. These pathways are evaluated for different receptors where the pathways are considered potentially complete and significant. Overlapping exposures that may occur for the different receptors are discussed further in Section 3.3.

The following sections provide a more detailed discussion of the exposure pathways that are quantitatively evaluated in this BHHRA.

3.5.1 Direct Exposure to Beach Sediment

Based on current and future uses within the Study Area, incidental ingestion and dermal contact with beach sediment could occur within natural river beach areas identified as human use areas in the Programmatic Work Plan. These areas were further classified with respect to the type of exposures that could occur, including recreational, fishing, transient, or dockside worker use areas. Human use areas in the Study Area and their associated classifications are shown in Map 2-1. Direct exposure to beach sediments is considered to be a potentially complete pathway for dockside workers, transients, recreational beach users, and recreational, subsistence, and tribal fishers.

3.5.2 Direct Exposure to In-Water Sediment

Direct contact with in-water sediment could occur during activities conducted from a boat or other vessel that result in bringing sediment to the surface, during diving, or when fishing as a result of handling anchors, hooks, or crayfish pots. Hence, direct exposure to in-water sediment is considered to be a potentially complete pathway for in-water workers, divers, and recreational, subsistence, and tribal fishers. Although recreational beach users may contact in-water sediment while swimming, such exposures are not expected to be significant and were not quantitatively evaluated in the risk assessment. Exposure to in-water sediment was evaluated throughout the Study Area by half-mile river segments for each side of the river rather than at specific areas as was done with exposure to beach sediments.

3.5.3 Direct Exposure to Surface Water

Direct exposure to contaminants in surface water could occur during recreation or occupational activities that occur near or in the water, or from future use of the LWR as a domestic water source. Transients may also use surface water as a source of drinking water or for bathing. Accordingly, direct exposure via ingestion and dermal contact with surface water is considered to be a potentially complete pathway for transients, recreational beach users, divers, and future domestic water users.

Exposure to contaminants in surface water via dermal absorption and ingestion were considered potentially complete but insignificant pathways for dockside workers, in-water workers, tribal fishers, and fishers. It is unlikely that dockside and in-water workers would have direct contact with surface water on a regular basis, and the potential for significant exposure is considered low while fishing. Additionally, although contaminants may volatilize from water , it is unlikely to result in a significant exposure considering the amount of mixing with ambient air and the relatively low concentrations of VOCs in water. Hence, inhalation of volatiles to ambient air was considered a potentially complete but insignificant exposure pathway for all receptors.

3.5.4 Direct Exposure to Groundwater from Seeps

Direct contact with groundwater is assumed to occur only at seeps where groundwater comes to the surface on a beach above the water line. Direct exposure to groundwater via seeps is considered a potentially complete exposure pathway for transients and recreational beach users. As described in Section 2.1.4, a seep reconnaissance survey identified only Outfall 22B, which is located at approximately RM 7W in an area designated as a potentially used by transients. Therefore, exposure to surface water from the groundwater seep at Outfall 22B was evaluated only for transients.

3.5.5 Consumption of Fish

Many of the contaminants found in Portland Harbor are persistent in the environment and accumulate in the food-chain. Local populations who consume fish caught in Portland Harbor may be exposed to COPCs that bioaccumulate in fish. While the populations evaluated in this BHHRA are described as "fishers," the fish consumption evaluation in this BHHRA includes people who consume fish caught within the Study Area, not just those who catch the fish. Consumption of locally-caught fish is evaluated as a potentially complete exposure pathway for dockside workers, in-water workers, recreational beach users, and divers. Consumption of fish by these populations is evaluated under the recreational and subsistence fisher receptor. By definition, ongoing long-term fish consumption by transients would not be expected to occur, and the evaluation of fish consumption for other receptors is considered to be protective of consumption of fish by transients.

3.5.6 Consumption of Shellfish

Certain contaminants can bioaccumulate in shellfish, and populations may be exposed to COPCs through consumption of shellfish that are collected within the Study Area. The actual extent shellfish harvesting and consumption is presently occurring is not known. The Linnton Community Center project (Wagner 2004) reported that some transients reported eating clams and crayfish, although many of the individuals indicated that they were in the area temporarily, move from location to location frequently, or have variable diets based on what is easily available. The Superfund Health Investigation and Education (SHINE) program in the Oregon Department of Human Services (DHS) stated that is unknown whether or not crayfish are harvested commercially within Portland Harbor (ATSDR 2006). ODFW has records for crayfish collection in the Columbia and Willamette Rivers, but these records do not indicate whether the collection actually occurs within the Study Area. Based on ODFW's data for 2005 to 2007, no commercial crayfish landings were reported for the Willamette River in Multnomah County. DHS had previously received information from ODFW indicating that an average of 4,300 pounds of crayfish were harvested commercially from the portion of the Willamette River within Multnomah County each of the five years from 1997-2001. In addition, DHS occasionally receives calls from citizens who are interested in harvesting crayfish from local waters and are interested in fish advisory information. According to a member of the Oregon Bass and Panfish club, traps are placed in the Portland Harbor Superfund Site boundaries and crayfish collected for bait and possibly for consumption (ATSDR 2006). Although consumption of shellfish was considered a potentially complete pathway for dockside workers, in-water workers, recreational beach users, divers, and recreational fishers, it was quantitatively evaluated only for subsistence fishers, as they were considered the most likely population to regularly harvest and consume shellfish.

3.5.7 Infant Consumption of Human Milk

Lipid-soluble chemicals can accumulate in body fat, including lipids found in breast-milk. As a result, breast-feeding represents a potentially complete exposure pathway for nursing infants. Accordingly, infant exposures to PCBs, dioxins/furans, DDx, and PDBEs were evaluated as a potentially complete exposure pathway wherever maternal exposure to those compounds was evaluated..

3.5.8 Potentially Overlapping Exposure Scenarios

An estimate of reasonable maximum exposure should not only address exposure for individual pathways, but also exposures that may occur across multiple exposure routes. Examples of overlapping scenarios include in-water workers who fish recreationally, and may also be recreational beach users. Potentially overlapping scenarios are indicated on Figure 3-1, and risks from potentially overlapping scenarios are discussed in Section 5.

3.6 CALCULATION OF EXPOSURE POINT CONCENTRATIONS

The exposure point concentration (EPC) is defined as the average concentration contacted at the exposure point(s) over the duration of the exposure period (EPA, 1992a). EPA recommends using the average concentration to represent "a reasonable estimate of the concentration likely to be contacted over time" (EPA 1989). Use of the average concentration also coincides with EPA toxicity criteria, which are based on lifetime average exposures. Because of the uncertainty associated with estimating the true average concentration at a site, EPA guidance (EPA 1989, 1992) notes that the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable. The UCL is defined as a value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true population mean 95 percent of the time. Use of the UCL can also help account for uncertainties that can result from limited sampling data, and more accurately accounts for the uneven spatial distribution of contaminant concentrations. The process to calculate EPCs for tissue and beach sediment was previously described in the Programmatic Work Plan, and Round 1 tissue EPCs were previously presented in *Round 1 Tissue Exposure Point Concentrations* (Kennedy/Jenks Consultants 2004b) and *Salmon, Lamprey, and Sturgeon Tissue Exposure Point Concentrations for Oregon Department of Human Services* (Kennedy/Jenks Consultants 2004c), both of which were approved by EPA. The process for deriving EPCs for in-water sediment, surface water, and groundwater seeps was previously described in *Exposure Point Concentration Calculation Approach and Summary of Exposure Factors* (Kennedy/Jenks Consultants 2006), as approved by EPA.

EPCs for RME evaluations represent either the 95 percent UCL, or the maximum detected value when either there was insufficient data to calculate a UCL or the calculated UCL was greater than the maximum reported value. Although inconsistent with EPA guidance (EPA 1992), EPCs for sediment and surface water CT evaluations were calculated as the simple arithmetic mean because such an evaluation is consistent with OAR 340-122-0084(1)(g) and the primary purpose of the CT evaluations is that they provide bounding information to evaluate uncertainties in the RME evaluation in this risk assessment. EPCs for fish/shellfish consumption scenarios are the lesser of the 95 percent UCL or the maximum detected concentration, central tendency evaluations were achieved by using mean or median consumption rates. For analytes with less than 5 detected concentrations, the maximum detected concentration for that exposure area was used as the EPC for the RME evaluation. The uncertainties associated with estimating EPCs from small datasets and with using the maximum detected concentration as the EPC are discussed in Section 6. The 95 percent UCLs were calculated for each dataset following EPA guidance (EPA 2002a and EPA 2007b). ProUCL version 4.00.02 (EPA 2007b) was used to test datasets for normal, lognormal, or gamma distributions and to calculate the 95 percent UCLs. If the data did not exhibit a discernable distribution, a non-parametric approach was used to generate a UCL. The 95 percent UCLs were calculated using the method recommended by ProUCL guidance (EPA 2007b).

Prior to calculating EPCs, the data were evaluated to address reporting of multiple results for the same analyte in the same sample and to reduce laboratory duplicates and field splits of samples to derive a single value for use. Data reductions performed within the SCRA database followed the rules described in *Guidelines for Data Reporting, Data Averaging, and Treatment of Non-Detected Values for the Round 1 Database Technical Memorandum* (Kennedy/Jenks Consultants et al. 2004). Sample results are reported as not detected when the concentration of the analyte in the sample is less than the detection limit. The actual concentration may be zero, or some value between zero and the detection limit. The following rules were applied to the dataset for tissue, sediment, surface water, and groundwater seep samples:

1. A chemical was assumed to not be present if was not detected in any sample for a given medium within the Study Area, an EPC was not calculated for that chemical in that medium

2. A chemical was presumed to be present if it was detected at least once within the Study Area in samples for a given medium. When calculating the 95 percent UCL, non-detects were used in the calculation as recommended by the ProUCL software. ProUCL software output for the 95 percent UCLs calculated in this BHHRA are provided in Attachment F4. When calculating the simple mean, non-detected values were replaced with one half their detection limit in the calculations.

3. Non-detects for which the detection limit was greater than the maximum detected concentration in an exposure area were removed from the dataset prior to calculating EPCs.

Certain toxicity values are based on exposure to chemical mixtures rather than to individual chemicals, as identified in *Human Health Toxicity Values Interim Deliverable* (Kennedy/Jenks Consultants 2004a). Concentrations of the individual isomers or congeners that comprise the mixtures were summed as described in Section 2.2.8 to calculate the EPCs for the mixtures, and the risks from these chemicals were evaluated on the basis of the combined mixture rather than for individual chemicals.

3.6.1 Beach Sediment

EPCs for beach sediment were calculated using data collected during Rounds 1 and 2 from locations designated as human use areas during Round 1 and 2, beach sediment data was not collected from human use areas during Round 3. One composite sample was collected from each beach area, and the results from each composite sample were was as the EPC for the RME and CT evaluations. When evaluating exposure for dockside workers at industrial sites, the same EPC was used to represent adjacent sites in instances where the beach area extended across individual site boundaries. Otherwise, each designated beach area was evaluated as a single exposure area for transients, recreational beach users, and recreational, subsistence and tribal fishers. Beach sediment exposure areas are presented on Map 2-1, EPCs for dockside workers are presented in Table 3-2, EPCs for transient, recreational, and fishing uses are presented in Table 3-3.

3.6.2 In-Water Sediment

Direct contact with in-water sediment is most likely to occur in the near-shore areas outside of the navigation channel. Thus, only surface sediment data collected less than 30.5 cm in depth and outside of the navigation channel were used to exposure to in-water sediments. In–water sediment EPCs are calculated in one-half mile segments along both sides of the river from RM 1.0 to RM 12.2, and for samples within Multnomah Channel. Study Area-wide EPCs were calculated using the sediment data collected between RM 1.9 and 11.8. In-water sediment EPCs for exposures by in-water workers, divers, and recreational/subsistence/tribal fishers are presented in Table 3-4.

3.6.3 Surface Water

Exposure concentrations in surface water were calculated using data collected within the Study Area, as well as the transect data collected from the mouth of Multnomah Channel. Both integrated and non-integrated water column samples were included in the data set, the specific samples used were dependent upon the anticipated exposures by the different receptors.

Surface water exposures by transients may occur throughout the year, EPCs were calculated using data from all seven seasonal sampling events. The data from each of the five transect locations were combined as described in Section 2.2.6. and EPCs were calculated for those five locations, at Willamette Cove using the discrete surface water samples, and on a Study Area-wide basis using the combined transect data from within the Study Area, excluding the transect location W027, which was collected at the mouth of Multnomah Channel. Surface water EPCs for exposures by transients are presented in Table 3-6.

Exposure to surface water by recreational beach users was assumed to occur primarily during summer months. Therefore, only data from the low-water sampling event conducted in July 2005 were used for calculating the surface water EPCs. These data were collected from recreational beaches in July 2005 included three transect locations and three single-point locations (Cathedral Park, Willamette Cove, and Swan Island Lagoon). Surface water EPCs for exposures by recreational beach users are presented in Table 3-7.

Exposures to surface water by divers were assumed to occur throughout the Study Area and were not considered seasonally dependent. EPCs were calculated in one-half mile intervals along each side of the river, and at each transect location. EPCs in surface water for exposures by divers are presented in Table 3-8.

Use of surface water as a domestic water source was assumed to have the potential to occur at any location through the Study Area on a year-round basis. Accordingly, data from all seven seasonal sampling events were used. EPCs were calculated for all individual transect stations and for single point stations with vertically integrated data. In addition, data from locations where co-located near-bottom and near-surface samples were collected were averaged and used in the domestic water dataset. Study Area-wide EPCs included all vertically integrated samples. EPCs for the use of surface water as a domestic water source are presented in Table 3-9.

3.6.4 Groundwater Seeps

As discussed Section 2.1.4, Outfall 22B, which is located on the west side of the river at RM 7, was the only seep identified where direct contact could occur within the Study Area. Data from two sampling events between 2002 and 2007 at times that did not involve stormwater influence were used to calculate the EPC, and the results are presented in Table 3-10.

3.6.5 Fish and Shellfish Tissue

EPCs for fish and shellfish tissue were calculated using data collected in the Round 1, Round 2, and Round 3 investigations, and the ODHS study. EPCs derived from Round 1 data were originally presented in *Round 1 Tissue Exposure Point Concentrations* (Kennedy/Jenks Consultants 2004b). EPCs derived using the results of the ODHS study were originally presented in *Salmon, Lamprey, and*

Sturgeon Tissue Exposure Point Concentrations for Oregon Department of Human Services (Kennedy/Jenks Consultants 2004c).

Smallmouth bass were collected and composited over a per river mile. EPCs—whole body and fillet—were calculated for smallmouth bass at each river mile as well as for the entire Study Area consistent with their small home range. Common carp, black crappie, and brown bullhead were collected and composited within river segments designated as fishing zones, which are consistent with the home ranges identified in the Programmatic Work Plan. Fishing zones in Round 1 were designated three-mile segments at RM 3-6 and RM 6-9. Round 3 included additional samples of common carp (but not black crappie or brown bullhead) from three separate four mile long fishing zones that extended over four-mile segments at RM 0-4, RM 4-8, and RM 8-12. EPCs for common carp, black crappie, and brown bullhead were calculated as whole body and fillet for each fishing zone from which they were sampled, as well as for the Study Area.

Adult salmon were collected at the Clackamas fish hatchery, adult lamprey were collected at Willamette Falls, and sturgeon were collected throughout the Study Area. Salmon were analyzed as whole body, fillet with skin, and fillet without skin composite samples. Lamprey were analyzed only as whole body composite samples, sturgeon were analyzed only as fillet without skin composite samples. EPCs were calculated for each species accordingly as average concentrations representative of the entire Study Area.

Crayfish and clams were collected and composited at each sampling location. EPCs for crayfish were calculated for each individual location as well as for the entire Study Area. EPCs for clams were calculated for both depurated and undepurated samples per river mile on each side of the river, as well as for the entire Study Area. EPCs were also calculated for crayfish and clams collected between RM 1.0 and 1.9 and between RM 11.8 and 12.2, per an agreement with EPA.

EPCs for fish tissue are presented in Tables 3-11 through 3-21, and EPCs for shellfish tissue are presented in Tables 3-22 through 3-25.

3.7 ESTIMATION OF CHEMICAL INTAKES

The amount of each chemical incorporated into the body is defined as the dose and is expressed in units of milligrams per kilogram per day (mg/kg-day). The dose is calculated differently when evaluating carcinogenic effects than when evaluating noncarcinogenic effects. Each is described below:

Non-cancer effects: The dose is averaged over the estimated exposure period and is expressed as a chronic daily intake (CDI). Thus, the CDI is used to represent the potential for adverse health effects over the period of exposure.

Carcinogenic effects: The dose is based on the estimated exposure duration, extrapolated over an estimated 70-year lifetime, representing the lifetime average daily intake (LADI). This is consistent with the cancer slope factors, which are based on lifetime exposures, and on the assumptions that the risk of carcinogenic effects is cumulative and continues even after exposure has ceased.

For non-occupational scenarios where exposures to children are considered likely, both adult and child receptors were evaluated. Children often exhibit behavior such as outdoor play activities and greater hand-to-mouth contact that can result in greater exposure than for a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake. Because cancer risks are averaged over a lifetime, they are directly proportional to the exposure duration as well as the dose and the potency of the chemical. Accordingly, cancer risks were also assessed for a combined exposure from childhood through adult years, to account for the increased relative exposure and susceptibility associated with childhood exposures.

Superfund exposure assessments should be conducted such that the intake variables for an exposure pathway should result in an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions (EPA, 1989). The RME is defined as the highest exposure that is reasonably expected to occur at a site. The intent is to estimate an exposure that is substantially greater than the average, yet is still within the range of possible exposures. In general, this is accomplished by using a combination of 90th or 95th percentile values for contact rate, exposure frequency and duration, and 50th percentile values for other variables. This BHHRA also evaluated central tendency (CT) exposures, which is intended to represent an average exposure by the affected population. Rationale and/or references for each of the RME and CT values for exposure pathways that were quantitatively assessed for each exposure scenario for different populations are presented in exposure factor Tables 3-26 through 3-30 and discussed in the following sections.

3.7.1 Incidental Ingestion of Sediment

The following equation was used to calculate the intake (expressed as milligrams per kilogram per day [mg/kg-day]) associated with the incidental ingestion of contaminants in soil or sediment:

$$CDI / LADI = \frac{C_s \times IRS \times 10^{-6}\, kg/mg \times EF \times ED}{BW \times AT}$$

Age-weighted exposures for the combined child and adult receptors were calculated consistent with the following equations:

$$CDI / LADI = \frac{C_s \times IFS_{adj} \times EF \times 10^{-6}\, kg/mg}{AT}$$

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{ED_a \times IRS_a}{BW_a}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
IFS_{adj} = age-adjusted soil/sediment ingestion factor [(mg-year)/(kg-day)]
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)
EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating chemical intake from the ingestion of chemicals in sediment are provided in Tables 3-26 and 3-27.

3.7.2 Dermal Contact with Sediment

The following equation was used to calculate exposure resulting from dermal contact with contaminants in soil or sediment:

$$CDI\ /\ LADI = \frac{C_S \times ABS \times SA \times AF \times EF \times ED \times 10^{-6}\ kg/mg}{BW \times AT}$$

Combined child and adult age-weighted exposures resulting from dermal contact with contaminants in sediment for the recreational beach user exposure scenarios were calculated consistent with the following equations:

$$CDI\ /\ LADI = \frac{C_S \times SFS_{adj} \times ABS \times EF \times 10^{-6}\ kg/mg}{AT}$$

where:

$$SFS_{adj} = \frac{ED_c \times AF_c \times SA_c}{BW_c} + \frac{ED_a \times AF_a \times SA_a}{BW_a}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
SFS_{adj} = age-adjusted dermal contact factor [(mg-year)/(kg-day)]
ABS = absorption efficiency
SA_a = adult exposed skin surface area (square centimeters [cm^2])

SA_c = child exposed skin surface area (cm^2)
AF_a = adult soil-to-skin adherence factor (mg/cm^2)
AF_c = child soil-to-skin adherence factor (mg/cm^2)
EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating exposure from dermal contact with soil or sediment are provided in Tables 3-26 and 3-27.

Dermal absorption of chemicals from soil or sediment adhered to the skin is dependent on a variety of factors, including the condition of the skin, the nature of adhered soil/sediment, and the chemical concentration. Dermal absorption factors, representing the fraction of a chemical absorbed from soil or sediment adhered to the skin, are presented in Table 3-31. Only those compounds or classes of compounds for which dermal absorption factors are presented were evaluated quantitatively via dermal contact, although assuming less than complete absorption may not fully describe risks associated with dermally active compound such as carcinogenic PAHs. The uncertainties associated with the exposure and risk estimates via dermal exposures with soil and sediments are presented in Section 6.

3.7.2.1 Ingestion of Surface Water

Exposure resulting from ingestion of surface water was evaluated using the following equation:

$$CDI / LADI = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT}$$

Combined child and adult age-weighted exposures due to ingestion of surface water were calculated consistent with the following equations:

$$CDI / LADI = \frac{C_w \times IFW_{adj} \times EF}{AT}$$

where:

$$IFW_{adj} = \frac{ED_c \times IRW_c}{BW_c} + \frac{ED_a \times IRW_a}{BW_a}$$

where:

C_W = chemical concentration in water (mg/L)
IFW_{adj} = age-adjusted water ingestion factor [(L-year)/(kg-day)]

IRW_a = adult groundwater ingestion rate (L/day)
IRW_c = child groundwater ingestion rate (L/day)
EF = exposure frequency (days/year)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT = averaging time (days)

The exposure assumptions for estimating chemical intake from the ingestion of groundwater or surface water are provided in Tables 3-28 and 3-30.

3.7.3 Dermal Contact with Surface Water

Dermal absorption of contaminants due to direct contact with surface water was evaluated using the following equation:

$$CDI\ /\ LADI = \frac{DA_{event} \times EV \times EF \times ED \times EF \times SA}{AT \times BW}$$

The combined child and adult age-weighted exposure was calculated consistent with the following equations:

$$CDI\ /\ LADI = \frac{C_w \times SFW_{adj} \times K_p \times EF \times ET \times CF}{AT}$$

where:

$$SFW_{adj} = \frac{ED_c \times SA_c}{BW_c} + \frac{ED_a \times SA_a}{BW_a}$$

Where:

C_w = chemical concentration in water (mg/L)
DA_{event} = dermally absorbed dose (mg/cm^2-event)
SFW_{adj} = age-adjusted water dermal contact factor [(cm^2-year)/kg]
K_p = dermal permeability coefficient (cm/hour)
EV = events per day
EF = exposure frequency (days/year)
ET = exposure time (hour)
CF = Conversion Factor (0.001 L/cubic centimeter)
ED_a = adult exposure duration (years)
ED_c = child exposure duration (years)
SA_a = adult exposed skin surface area (cm^2)
SA_c = child exposed skin surface area (cm^2)
BW_a = adult body weight (kg)

BW_c = child body weight (kg)
AT = averaging time (days)

The absorbed dose per event (DA_{event}) for assessing direct contact with water was calculated using the chemical-specific factors presented in Tables 3-32 and 3-33. These values were obtained from Appendix B of EPA's Supplemental Guidance for Dermal Risk Assessment (2004). The uncertainties associated with calculating DA_{event} for chemicals with factors outside of the predictive domain are discussed in Section 6.

3.7.4 Consumption of Fish/Shellfish

The following equation was used to estimate exposure associated with the consumption of fish and shellfish:

$$CDI / LADI = \frac{C_t \times IR \times 10^{-3}\, kg/g \times EF \times ED}{BW \times AT}$$

Combined child and adult exposure was evaluated consistent with the following equation:

$$CDI / LADI = \frac{C_t \times IR_{t-adj} \times 10^{-3}\, kg/g \times EF}{AT}$$

where:

$$IR_{t-adj} = \frac{ED_c \times IR_c}{BW_c} + \frac{ED_a \times IR_a}{BW_a}$$

where:

C_t = Contaminant concentration in fish tissue (mg/kg, wet-weight basis)
IR_c = Fish consumption rate - child (g/day, wet-weight basis)
IR_a = Fish consumption rate - adult (g/day, wet-weight basis)
EF = Exposure frequency (days/year)
ED_c = Exposure duration – child (years)
ED_a = Exposure duration – adult (years)
BW_c = Body weight – child (kg)
BW_a = Body weight – adult (kg)
AT = Averaging time (days)

The exposure assumptions used to estimate exposure from fish consumption are presented in Table 3-29.

3.7.5 Calculation of Intake due to Infant Consumption of Human Milk

Exposure to breastfeeding infants due to consumption of human milk was evaluated using a methodology developed by ODEQ, OHA, and EPA Region 10, adapted from EPA's Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions (EPA 1998a) and the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 2005a), and is described in detail in Appendix D of the DEQ Human Health Risk Assessment Guidance (DEQ 2010). The evaluation for this pathway focuses on PCBs, dioxins/furans, DDx, and PDBEs because of the propensity of these chemicals to bioaccumulate. Because the concentration of lipophilic chemicals in human milk is most directly correlated with the steady-state body burden, which itself is directly related to the long-term intake of the chemical, the daily maternal absorbed intake is calculated from the average daily dose to the mother (as calculated in the preceding sections) using the following equation:

$$DAI_{maternal} = ADD_{maternal} \times AE$$

where:

$DAI_{maternal}$ = daily absorbed intake of the mother (mg/kg-day)
$ADD_{maternal}$ = age-adjusted soil/sediment ingestion factor (mg/kg-day)
AE = absorption efficiency of the chemical

The steady-state chemical concentration in milk fat is then calculated as:

$$C_{milkfat} = \frac{DAI_{maternal} \times h \times f_f}{ln(2) \times f_{fm}}$$

where:

$C_{milkfat}$ = chemical concentration in milk fat (mg/kg-lipid)
$DAI_{maternal}$ = daily absorbed intake of the mother (mg/kg-day)
h = half-life of chemical (days)
f_f = fraction of absorbed chemical stored in fat
f_{fm} = fraction of mother's weight that is fat

Intake for infants via breastfeeding is then calculated as:

$$Intake = \frac{C_{milkfat} \times f_{mbm} \times CR_{milk} \times ED_{inf}}{BW_{inf} \times AT}$$

where:

f_{mbm} = fraction of fat in breast milk
CR_{milk} = consumption rate of breast milk (kg/day)
ED_{inf} = exposure duration of breastfeeding infant (days)

BW_{inf} = average infant body weight (kg)
AT = averaging time (days)

Additional information regarding the evaluation of persistent, bioaccumulative COPCs is presented in Section 5.1.3.

3.7.6 Calculation of Intake for Mutagenic COPCs

Early-in-life susceptibility to carcinogens has long been recognized by the scientific community as a public health concern. In its revised Cancer Assessment Guidelines, EPA concluded that existing risk assessment approaches did not adequately address the possibility that exposures to a chemical in early life may can result in higher lifetime cancer risks than a comparable duration adult exposure (EPA 2005b). In order to address this increased risk, the agency recommends use of a potency adjustment to account for early-in-life exposures. When no chemical-specific data are available to assess directly cancer susceptibility from early-life exposure, the following default Age Dependent Adjustment Factors (ADAFs) are recommended to be used when evaluating a carcinogen known to cause cancer through a mutagenic mode of action.

- 10-fold adjustment for exposures during the first 2 years of life;
- 3-fold adjustment for exposures from ages 2 to <16 years of age; and
- No adjustment for exposures after turning 16 years of age.

Of the COPCs evaluated in this HHRA, EPA considers that there is sufficient weight-of-evidence to conclude the carcinogenic PAHs cause cancer through a mutagenic mode of action.

3.7.7 Incidental Ingestion of Sediment

The following equation was used to calculate the intake in mg/kg-day for mutagenic COPCs associated with incidental ingestion of soil or sediment:

$$CDI/LADI = \frac{C_s \times \begin{pmatrix} \frac{(ED_{0\text{-}2} \times IRS_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRS_c) \times 3}{BW_c} + \\ \frac{(ED_{6\text{-}16} \times IRS_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRS_a) \times 1}{BW_a} \end{pmatrix} \times EF}{AT}$$

where:

C_s = chemical concentration in soil or sediment (mg/kg)
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)

EF	=	exposure frequency (days/year)
ED_{0-2}	=	exposure duration ages 0-2 (years)
ED_{2-6}	=	exposure duration ages 2-6 (years)
ED_{6-16}	=	exposure duration ages 6-16 (years)
ED_{16-30}	=	exposure duration ages 16-30 (years)
BW_a	=	adult body weight (kg)
BW_c	=	child body weight (kg)
AT	=	averaging time (days)

3.7.8 Dermal Contact with Sediment

The following equation was used to calculate the intake from dermal contact with contaminants in soil or sediment:

$$CDI / LADI = \frac{C_S \times \left(\begin{array}{c} \frac{ED_{0\text{-}2} \times AF_c \times SA_c \times 10}{BW_c} + \frac{ED_{2\text{-}6} \times AF_c \times SA_c \times 3}{BW_c} + \\ \frac{ED_{6\text{-}16} \times AF_a \times SA_a \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times AF_a \times SA_a \times 1}{BW_a} \end{array} \right) \times ABS \times EF \times 10^{-6} kg/mg}{AT}$$

where:

C_s	=	chemical concentration in soil or sediment (mg/kg)
ABS	=	absorption efficiency
SA_a	=	adult exposed skin surface area (square centimeters [cm^2])
SA_c	=	child exposed skin surface area (cm^2)
AF_a	=	adult soil-to-skin adherence factor (mg/cm^2)
AF_c	=	child soil-to-skin adherence factor (mg/cm^2)
EF=	=	exposure frequency (days/year)
ED_{0-2}	=	exposure duration ages 0-2 (years)
ED_{2-6}	=	exposure duration ages 2-6 (years)
ED_{6-16}	=	exposure duration ages 6-16 (years)
ED_{16-30}	=	exposure duration ages 16-30 (years)
BW_a	=	adult body weight (kg)
BW_c	=	child body weight (kg)
AT	=	averaging time (days)

3.7.9 Ingestion of Surface Water

The following equation was used to calculate intake of chemicals associated with ingestion of surface water:

$$CDI/LADI = \frac{C_w \times \left(\frac{(ED_{0\text{-}2} \times IRW_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRW_c) \times 3}{BW_c} + \frac{(ED_{6\text{-}16} \times IRW_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRW_a) \times 1}{BW_a} \right) \times EF}{AT}$$

where:

C_w	=	chemical concentration in water (mg/L)
IFW_{adj}	=	age-adjusted water ingestion factor [(L-year)/(kg-day)]
IRW_a	=	adult groundwater ingestion rate (L/day)
IRW_c	=	child groundwater ingestion rate (L/day)
EF	=	exposure frequency (days/year)
$ED_{0\text{-}2}$	=	exposure duration ages 0-2 (years)
$ED_{2\text{-}6}$	=	exposure duration ages 2-6 (years)
$ED_{6\text{-}16}$	=	exposure duration ages 6-16 (years)
$ED_{16\text{-}30}$	=	exposure duration ages 16-30 (years)
BW_a	=	adult body weight (kg)
BW_c	=	child body weight (kg)
AT	=	averaging time (days)

The exposure parameters are presented in Tables 3-26 to 3-30.

3.7.10 Population-Specific Exposure Assumptions

Assumptions about each receptor population evaluated in this BHHRA were used to select exposure parameters used to calculate the pathway-specific chemical intakes. Site-specific values are not available for all populations and pathways. Therefore, default values representative of the general U.S. population (EPA 1991b) or values representing best professional judgment based on known human uses of the Study Area were used. The majority of the exposure parameters used in this BHHRA were previously described in the *Exposure Point Concentration Calculation Approach and Summary of Exposure Factors* (Kennedy/Jenks Consultants 2006), which was approved by EPA. Exposure parameters for divers were provided by EPA in its comments on the Round 2 Report. The exposure parameters are discussed below and presented in Tables 3-26 to 3-30. These values represent potential exposures for application at appropriate areas and/or areas agreed upon with EPA and its partners within the Study Area.

3.7.10.1 Dockside Workers

Exposure frequency for dockside workers was assumed to be 50 days/year for the RME evaluation, and 44 days/year the CT evaluation. The RME value assumes a dockside worker is exposed to beach sediment one day per week for 50 weeks each year (50 weeks/year is based on the average number of days worked by an outdoor worker as being 225 days/year, according to the U.S. Census Bureau's *1990 Earnings by Occupation and Education Survey,* and assuming a 5-day work week). An exposure duration of 25 years was used, representing an EPA default value for the RME estimate of job tenure. This value is consistent with data from the U.S. Bureau of Labor Statistics showing that the 95th percentile job tenure for men in the manufacturing sector is 25 years. The CT estimate assumed duration of 9 years, representing approximately the 50th percentile of residence time estimates from the U.S. Census Bureau data (EPA, 1997).

A sediment ingestion rate of 200 mg/day was used for the RME evaluation, based on EPA Region 10 supplemental guidance on soil ingestion rates (EPA, 2000a), and is representative of approximately the midpoint between the recommended values of 100 mg/day for outdoor workers and 330 mg/day for construction workers. An ingestion rate of 50 mg/day was used to estimate CT exposure.

Dermal exposure was assessed assuming that the face, forearms and hands are exposed, representing an exposed skin surface area of 3,300 cm^2, which is representative of the median value (50th percentile) for adults. A body weight of 70 kg, representing the 50th percentile of mean body weights of men and women combined (EPA, 1997a) was used for all adult receptors. RME and CT exposure values for dockside workers are presented in Table 3-26.

3.7.10.2 In-Water Workers

According to the Army Corps of Engineers (Siipola 2004), the Port of Portland conducts the most frequent dredging within the Study Area, thus the exposure factors for workers at Terminal 4 are considered protective of in-water workers for potential in-water sediment exposures throughout the Study Area. Exposure factors for in-water workers were developed based on in-depth interviews with several workers at Terminal 4 who either conduct or oversee activities that could result in contact with in-water sediment. For the RME evaluation, in-water sediment exposures were assumed to occur for 10 of 25 years of employment at a given facility, with an exposure frequency of 10 days of sediment contact per year. For the CT evaluation, contact with in-water sediment is assumed for 4 of 9 years employment at a given facility, with an exposure frequency of 10 days of sediment contact per year. Intake rates for in-water sediment are the same as those used for the dockside worker, which are the default ingestion rate of soil for an industrial worker. RME and CT exposure values for the in-water worker are presented in Table 3-27.

3.7.10.3 Divers

Two different scenarios were evaluated, based on whether the divers wear wet or dry suits. Divers wearing wet suits are assumed to be working as commercial divers without a full face mask, and wearing either wet gloves or no gloves. An exposure frequency of 5 days/year for the RME evaluation and 2 days/year for the CT evaluation are based on best professional judgment and discussions between EPA, LWG, and commercial divers, as well as the experience of EPA divers who work at the Portland Harbor Superfund site. Exposure durations of 25 years and 9 years were used for the RME and CT estimates, respectively, based on the labor statistics for job tenure described in Section 3.5.9.1.

Sediment ingestion rates were assumed to be 50 percent of the ingestion rate for dockside workers, corresponding to values of 50 mg/day and 25 mg/day, respectively for the RME and CT evaluations. Dermal exposure to sediment for divers wearing a wet suit was evaluated assuming the entire skin surface area was exposed. A value of 18,150 cm^2, representing the median skin surface area for men and women was used for both the RME and CT evaluations. Divers wearing a dry suit (with a neck dam) would likely have only their head, neck, and hands exposure, and a RME value of 2,510 cm^2 was used. Sediment dermal adherence factors for of 0.3 mg/cm^2-event and 0.07 mg/cm^2 event was used for the was used for the RME estimate and CT estimate, respectively. A CT evaluation was not done for divers wearing dry suits.

Incidental ingestion of surface water for both diver scenarios was assumed to be 50 mL/hour for both the RME and CT evaluations (EPA 1989). More recent data regarding estimates of the amount of water ingested by commercial divers indicates that on average, occupational divers ingested 6 mL/dive in freshwater and 10 mL/dive in marine water, with the maximum estimated ingestion ranging between 25 and 100/mL/dive (EPA 2011). Exposure via ingestion and dermal contact was assumed to occur for 4 hours/event for the RME estimate and 2 hours/event for the CT estimate.

Tables 3-27 and 3-28 summarize exposure assumptions for the wet suit and dry suit divers for in-water sediment and surface water, respectively.

3.7.10.4 Transients

Little information is available regarding how long individuals may remain at specific locations or within the Study Area itself. Based on professional judgment, an exposure duration of 2 years was assumed for the RME and 1 year for CT evaluations, exposure frequency was assumed to be daily (365 days/year). Incidental ingestion of sediment was evaluated at the same rates used for the dockside workers (200 mg/day). Dermal exposure was assessed assuming that the face, forearms and hands, and lower legs are exposed, representing an exposed skin surface area of 5,700 cm^2, which represents the median value for adults. A soil adherence factor of 0.3 mg/cm^2 was used based on the expectation that beach sediment would have a greater moisture content than dry soil. An ingestion rate of 2 L/day was used for consumption of surface water, which represents the default value for domestic water use. Tables 3-26 and 3-28 summarize RME and CT exposure values for the transient scenario for beach sediment and surface water, and the reference and rationale for each value.

3.7.10.5 Recreational Beach User

In the absence of specific information regarding the frequency of recreational activities in Portland Harbor, potential exposures are based on best professional judgment, assuming that beach use is most frequent in the summer, with less frequent use in the spring/fall, and only intermittent use in the winter. An exposure frequency of 94 days/year (5 days/week during summer, 1 day/week during spring/fall, and 1 day/month during winter) was used for the RME estimate and 38 days/year (2 days/week during summer, 2 days/month during spring/fall) was used for the CT estimate. Exposure duration for recreational activities is based on the assumption that individuals are largely permanent residents of the Portland area. Accordingly, an exposure duration of 30 years, which represents approximately the 95th percentile of the length of continuous residence in a single location in the U.S. population (EPA 1997) was used for the RME estimate. More recent studies described in the 2011 edition of EPA's Exposure Factors Handbook show the 95th percentile value is closer to 33 years, data from the U.S. Census Bureau indicate that 32 years represents the best estimate of residence time at the 90th percentile. However, the value of 30 years is consistent with other Superfund risk assessments nationwide, and represents a reasonably conservative estimate of total residence time in the area. An exposure duration of 9 years was used for the CT estimate.

Sediment ingestion rates of 100 mg/day for adults and 200 mg/day for children were used, approximating the 95th percentile soil ingestion rates. CT estimates assumed sediment ingestion rates of 100 mg/day for children and 50 mg/day for adults. Dermal exposures were evaluated assuming that the face, forearms and hands, and lower legs are exposed. Median values of 5,700 cm^2 and 2,800 cm^2 were used for adults and children, respectively. A soil-skin adherence of 3.3 mg/cm^2-day was used for children to account for the greater moisture content of beach sediment.

Water temperatures in the Lower Willamette River would typically limit swimming to the summer months, thus the RME estimates for swimming were assumed to occur at a rate of 26 days per year for adults and 65 days per year for children. As discussed in Section 3.5.10.3, incidental ingestion of river water was assumed to occur at a rate of 50 mL/hour while swimming. Based on current recommendations, 50 mL/hr represents mean value, assuming 21mL/hr for adults and 49 mL/hr for children, upper-percentile recommended values are 71 mL/hr for adults and 121 mL/hr for children (EPA 2011). Tables 3-26 and 3-28 summarize RME and CT exposure values for beach sediment and surface water, respectively, for adult and child recreational beach users.

3.7.10.6 Recreational/Subsistence Fishers

Because there is limited information regarding the frequency of fishing activities within the Study Area, a range of possible exposures was evaluated for people who engage in recreational or subsistence fishing activities by considering both a high- and a low-frequency rate of fishing. RME estimates for high-frequency (subsistence) fishers assumed a fishing frequency of 156 days/year, approximating a rate of

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3 days/week. Low-frequency (recreational) fishers were assumed to fish 104 days/year, approximating a rate of 2 days/week. CT estimates assumed a frequency of 52 days/year and 26 days/year for high- and low-frequency fishers, respectively, and are representative of assumed fishing frequencies of 1 day/week and 2 days/month. People engaged in recreational or subsistence fishing were also assumed to be residents of the greater Portland area, therefore exposure durations of 30 years and 9 years, were used for the RME and CT evaluations, respectively, based on the population statistics for residency discussed in Section 3.5.9.5.

Incidental ingestion of beach sediment was evaluated assuming 100 mg/day for the RME estimate and 50 mg/day for the CT estimate, representative of soil ingestion rates in a typical residential setting. Rates of 50 mg/day for the RME estimate and 25 mg/day for the CT estimate were used for incidental ingestion of in-water sediment, representing 50 percent of the rates used for beach sediment. An exposed surface area of 5,700 cm^2, representing the face, hands, forearms and lower legs was used to assess dermal exposure to beach sediments, exposures to in-water sediment was assumed to be limited to the hands and forearms, corresponding to a surface area of 1,980 cm^2. Sediment adherence to skin was evaluated using a weighted adherence factor based on exposure to the hands, forearms, and lower legs (EPA 2004). A factor of 25 percent was used to account for the time spent fishing in a single area within the Study Area. Exposure assumptions for beach and in-water sediment contact for recreational/subsistence fishers are presented in Tables 3-26 and 3-27

Information currently available indicates that spring Chinook salmon, steelhead, Coho salmon, shad, crappie, bass, and white sturgeon are the fish species preferred by local recreational fishers (DEQ 2000b, Hartman 2002, and Steele 2002). In addition to recreational fishing, an investigation by the Oregonian newspaper and limited surveys conducted on other portions of the Willamette River indicate that immigrants from Eastern Europe and Asia, African-Americans, and Hispanics are most likely to be catching and eating fish from the lower Willamette either as a supplemental or primary dietary source (ATSDR 2002). These surveys also indicate that the most commonly consumed species are carp, bullhead, catfish, and smallmouth bass, although other species may also be consumed. In conversations that were conducted as part of a project by the Linnton Community Center (Wagner 2004) about consumption of fish or shellfish from the Willamette River, transients reported consuming a large variety of fish, and several said they ate whatever they could catch themselves or obtain from other fishers.

No studies were located that document specific consumption rates of recreational or subsistence anglers in Portland Harbor prior to its listing as a Superfund site. Surveys conducted subsequent to the listing would not be representative of historical, baseline consumption patterns due to subsequent fish advisories and efforts to limit consumption of fish caught from the harbor. Therefore, fish consumption rates from published studies were used to describe the range of reasonably expected exposures relevant to the different populations known to occur in the Portland Harbor area.

Three different rates were evaluated: 17.5 grams per day (approximately 2 eight ounce meals per month), 73 g/ day (10 eight ounce meals per month), and 142 g/day per day (19 eight ounce meals per month). The term "recreational fishers" is intended to encompass a range of the population while focusing on those who may fish on a more-or-less regular basis, and "subsistence fishers" to represent populations with high fish consumption rates, recognizing that fish are not an exclusive source of protein in their diet. Accordingly, 17.5 g/day is considered representative of a CT value for recreational fishers, and 73 g/day was selected as the RME value representing the higher-end consumption practices of recreational fishers. The consumption rate of 142 g/day represents a RME value for high fish consuming, or subsistence, fishers. No CT value was selected because the evaluations based on 17.5 g/day and 73 g/day inform the risks associated with lower consumption rates. Consumption rates for children aged 6 years and younger were calculated by assuming that their rate of fish consumption is approximately 42 percent of an adult, based on the ratio of child-to-adult consumption rates presented in the CRITFC Fish Consumption Survey (CRITFC 1994). The corresponding rates that were used for children are 7 g/day, 31 g/day, and 60 g/day.

The rates of 17.5 g/day and 142 g/day represent the 90^{th} and 99^{th} percentiles, respectively, of per capita consumption of uncooked freshwater/estuarine finfish and shellfish by individuals (consumers and non-consumers) 18 or older, as reported in the Continuing Survey of Food Intakes by Individuals (CSFII) and described in EPA's Estimated Per Capita Fish Consumption in the United States (EPA 2002b). While the values are presented in terms of "uncooked weight," it should not be construed to imply that the fish are consumed raw, as the consumption rates represent adjusted values to account for the amount of fish needed to prepare specific meals. No adjustments were made to contaminant concentrations in raw fish tissue because of the uncertainties associated with accounting for specific preparation and cooking practices.

The CSFII surveys recorded food consumption for two non-consecutive days. "Consumers only" were defined as individuals who ate fish at least once during the 2-day reporting period, individuals who reported not consuming any fish during the reporting period were designated as "non-consumers." For comparison, the 90^{th} and 99^{th} percentile consumption rates for consumers-only are 200 g/day and 506 g/day, respectively (EPA 2002b). Because of the short time period over which the survey is conducted, the results characterize the empirical distribution of average daily per capita consumption rather than describe true long-term average daily intakes. Although 17.5 g/day represents a 90^{th} percentile value, it is considered an average consumption rate for sport fishers (EPA 2000d). Similarly, 142 g/day is considered to be representative of average consumption estimates for subsistence fishers when compared to upper percentile values for consumers only. However, the use of values representative of both non-consumers and consumers is appropriate as it accounts for the fact that some portion of the total diet of fish consumed may come from sources other than Portland Harbor. The consumption rate of 73 g/day is from a creel study conducted in the Columbia Slough, and represents the 95 percent upper confidence limit on the mean, where 75 percent of the mass of the total fish is consumed (Adolfson 1996).

Consumption of shellfish was evaluated considering only consumption by adults, and assuming that consumption of shellfish is primarily a component of a subsistence diet. Site-specific information regarding consumption of shellfish is not available, thus a range of consumption rates were evaluated. Consumption rates of 3.3 g/day and 18 g/day were selected as representative of CT and RME estimates. These values represent the 50^{th} and 95^{th} percentile consumption rates of shellfish from freshwater and estuarine systems for individuals of age 18 and older in the United States (EPA 2002b). Exposure assumptions for recreational/subsistence fish consumption are presented in Table 3-29, and the uncertainties associated with these consumption rates are discussed in Section 6.

3.7.10.7 Tribal Fishers

Specific information regarding population mobility on Native American populations is less readily available than for the general U.S. population. The evaluation of exposures to Native Americans was based on the premise that they spend their entire lives in the area (EPA 2005c), and a typical lifetime was evaluated as 70 years. Fishing frequency was assumed to be 260 days/yr (5 days/week) for the RME estimate and 104 days/year (2 days/week) for the CT estimate.

Incidental ingestion of beach sediment was evaluated assuming 100 mg/day for the RME estimate and 50 mg/day for the CT estimate. Rates of 50 mg/day for the RME estimate and 25 mg/day for the CT estimate were used for incidental ingestion of in-water sediment, representing 50 percent of the rates used for incidental soil ingestion in a typical residential setting. An exposed surface area of 5,700 cm^2, representing the face, hands, forearms and lower legs was used to assess dermal exposure to beach sediments, exposures to in-water sediment was assumed to be limited to the hands and forearms, corresponding to a surface area of 1,980 cm^2. Sediment adherence to skin was evaluated using a weighted adherence factor based on exposure to the hands, forearms, and lower legs (EPA 2004). A factor of 25 percent was used to account for the time spent fishing in a single area within the Study Area. Exposure assumptions for beach and in-water sediment contact for tribal fishers are presented in Tables 3-26 and 3-27.

Fish consumption by tribal members was evaluated assuming a multi-species diet that includes both resident and anadromous fish (salmon, lamprey, and sturgeon). An overall rate of 175 g/day (approximately 23 eight oz meals per month), representing the 95^{th} percentile of consumption rates for consumers and non-consumers in the CRITFC Survey was used for adult tribal fish consumers. A consumption rate of 73 g/day, representing the 95^{th} percentile of consumption for children from the CRITFC Survey was used for child tribal fish consumers. The CRITFC survey reported that none of the respondents fished the Willamette River for resident fish, and approximately 4 percent fished for anadromous fish. Overall fish consumption information from the CRITFC survey was used to determine the ingestion rate for each fish species, as shown in the following table:

Species	Grams per day[a]	Percent of diet
Salmon	67	38.4
Lamprey	12.3	7.0
Sturgeon	8.6	4.9
Smelt	12.5	7.2
Whitefish	23.2	13.3
Trout	25.1	14.3
Walleye	9.9	5.7
Northern Pikeminnow-	3.7	2.1
Sucker	7.3	4.2
Shad	5.2	3.0
Total Consumption Rate	175	100

(a) Rates are based on the weighted mean data in Table 18 of CRITFC 1994.

As shown, consumption rates of anadromous species account for approximately 50 percent of total intake. Consumption of salmon, lamprey and sturgeon were evaluated at rates of 67 g/day, 12.3 g/day, and 8.6 g/day, respectively. The remaining portion of the diet was evaluated assuming equal portions of the four resident fish (smallmouth bass, brown bullhead, common carp, and black crappie) for which tissue data were available. Consumption rates for children were calculated using the same dietary percentages as the adult tribal fish consumers and a total intake of 73 g/day. Exposure assumptions for tribal fish consumption are presented in Table 3-29. Adult salmon, adult lamprey, and sturgeon have life histories such that significant contaminant loading can occur outside of the Study Area, making it problematic to associate tissue concentrations with site contamination. However, including consumption of anadromous fish in conjunction with resident fish provides useful information regarding risks to tribal members who may fish the Lower Willamette River.

3.7.10.8 Domestic/Household Water User

Use of surface water as a household water source was evaluated assuming exposure occurs in a residential setting. Exposure frequency is assumed as 350 days per year (7 days/week for 50 weeks) for both the RME and CT evaluations. As discussed in Section 3.5.9.5, overall exposure duration for residential exposure was assessed as 30 years for the RME estimate and 9 years for the CT estimate. Water ingestion by adults was evaluated at a rate of 2 L/day for the RME estimate, representing the average of the 90^{th} percentiles of two national studies (EPA 1997a). A value of 1.4 L/day was used for the CT estimate, representing the population-weighted means of the same studies. These values are representative of water consumed directly from the tap or used in the preparation of food and beverages for adults. Ingestion rates representing 50^{th} percentile values of 1.4 L/day for RME and 0.9 L/day for CT were used for children aged 6 years and younger.

Dermal exposures during showering or bathing were evaluated assuming a rate of one event per day, with an event duration of 35 minutes (0.58 hr) for the RME and 15 minutes (0.15 hr) for the CT, representing the 95th and 50th percentile values from EPA 1997a. A total skin surface area of 18,000 cm^2, representing estimates of the 50th percentile of mean surface area for adult men and women (EPA 1997a), was used for both the RME and CT estimates. A corresponding mean surface area of 6,600 cm^2 was used for children aged 6 years and younger.

Table 3-30 summarizes the exposure assumptions used to evaluate domestic use of surface water.

3.7.11 Chemical-Specific Exposure Factors and Assumptions

In calculating chemical intakes, certain assumptions were made that were specific to a given chemical or class of chemicals. These chemical-specific assumptions had an effect on both EPCs and intake calculations, and are described below.

3.7.11.1 Arsenic

Although arsenic was analyzed as total arsenic, the toxicity values represent inorganic arsenic. In previous fish tissue studies in the lower Columbia and Willamette Rivers, the percent of inorganic arsenic relative to total arsenic ranged from 0.1 percent to 26.6 percent with an average of 5.3 percent inorganic arsenic in resident fish samples from the Willamette River (Tetra Tech 1995, EVS 2000). Shellfish may have a higher percentage of inorganic arsenic, as measured in studies on the Lower Duwamish River. The Columbia River Basin Fish Contaminant Survey (EPA 2002c) concluded that a “value of 10 percent is expected to result in a health protective estimate of the potential health effects from arsenic in fish.” Therefore, 10 percent of total arsenic in tissue was assumed to be inorganic arsenic when calculating. Uncertainties associated with the assumption that 10 percent of the total arsenic is in the inorganic form in fish and shellfish are discussed further in Section 6.

3.7.11.2 PCBs

PCBs were analyzed as Aroclors and congeners in tissue. Where PCBs were analyzed as Aroclors, the summed concentration of individual Aroclors was used in calculating the EPCs. Where PCBs were analyzed as congeners, EPCs were calculated using both the total PCB value (sum of individual congeners) and an adjusted total PCB value. The adjusted total PCB value was calculated by subtracting the concentration of the coplanar PCB congeners from the total PCB concentration. This was done because the coplanar PCB congeners were evaluated separately (as TCDD toxic equivalents [TEQs]) for cancer risks. Further explanation of how PCB congeners were summed is provided in as described in Section 2.2.8.

3.7.11.3 Oral Bioavailability Factors for Sediment

Consistent with EPA guidance (1989), the chemical intake equations calculate the amount of chemical at the human exchange boundaries, not the amount of chemical available for absorption. Therefore, the estimated intakes calculated in this BHHRA are not the same as the absorbed dose of a chemical. However, the toxicity of an ingested chemical depends on the degree to which the chemical is absorbed from the gastrointestinal tract into the body. Per EPA guidance (1989, 2007c), if the exposure medium in the risk assessment differs from the exposure medium assumed by the toxicity value an adjustment for bioavailability may be appropriate. For purposes of this BHHRA, oral bioavailability factors were not used to adjust the estimated exposures from COPCs in sediment. The uncertainties associated with not considering bioavailability in this BHHRA are discussed in Section 6.

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4.0 TOXICITY ASSESSMENT

The toxicity assessment is composed of two steps: (1) hazard identification and (2) dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical may result in a deleterious health effect in humans. It consists of characterizing the nature of the effect and the strength of the evidence that the chemical will cause the observed effect. Dose-response assessment characterizes the relationship between the dose and the incidence and/or severity of the adverse health effect in the exposed population. For risk assessment purposes, chemicals are generally separated into categories based on their toxicological endpoints. The primary basis of this categorization is whether a chemical exhibits potentially carcinogenic or noncarcinogenic health effects. Because chemicals that are suspected carcinogens may also give rise to noncarcinogenic effects, they must be evaluated separately for both effects.

4.1 TOXICITY VALUES FOR EVALUATING CARCINOGENIC EFFECTS

Cancer slope factors are used to estimate the risk of cancer associated with exposure to a chemical known or suspected to be carcinogenic. The slope factor is derived from either human epidemiological or animal studies, and represents an upper bound, generally approximating a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure by ingestion. Slope factors are generally expressed in units of proportion (of a population) affected per mg of substance/kg body weight-day ([(mg/kg-day)$^{-1}$].

In addition to the numerical estimates of carcinogenic potential, a cancer weight-of-evidence (WOE) descriptor is used to describe a substance's potential to cause cancer in humans and the conditions under which the carcinogenic effects may be expressed. This judgment is independent of consideration of the agent's carcinogenic potency. Under EPA's 1986 guidelines for carcinogen risk assessment, the WOE was described by categories "A through E"—Group A for known human carcinogens through Group E for agents with evidence of noncarcinogenicity. Under EPA's 2005 guidelines for carcinogen risk assessment, a narrative approach rather than the alphanumeric categories is used to characterize carcinogenicity. Five standard weight-of-evidence descriptors are used: *Carcinogenic to Humans, Likely to Be Carcinogenic to Humans, Suggestive Evidence of Carcinogenic Potential, Inadequate Information to Assess Carcinogenic Potential, and Not Likely to Be Carcinogenic to Humans).* Slope factors for assessing dermal exposure were derived as described in Section 4.7, and oral and dermal slope factors are presented in Table 4-1.

4.2 TOXICITY VALUES FOR EVALUATING NONCARCINOGENIC EFFECTS

The reference dose (RfD) provides quantitative information for use in risk assessments for health effects known or assumed to be produced through a nonlinear (possibly threshold) mode of action. The RfD, expressed in units of mg of substance/kg body weight-day (mg/kg-day) is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The use of RfDs is based on the concept that there is range of exposures that exist up to a finite value, or threshold, that can be tolerated without producing a toxic effect. Reference doses are presented in Table 4-2.

4.3 SOURCES OF TOXICITY VALUES

The following hierarchy of sources of toxicity values is currently recommended for use at Superfund sites (EPA 2003b):

- Tier 1 – EPA's Integrated Risk Information System (IRIS) database (EPA 2010b) is the preferred source of information because it normally represents the official EPA scientific position regarding the toxicity of the chemicals based on the data available at the time of the review. IRIS contains RfDs and cancer slope factor (SFs) that have gone through a peer review and EPA consensus review.
- Tier 2 - EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) are toxicity values derived for use in the Superfund Program when such values are not available in IRIS. PPRTVs are derived after a review of the relevant scientific literature using the methods, sources of data and guidance for value derivation used by the EPA IRIS Program. The PPRTV database includes RfDs and SFs that have undergone internal and external peer review. The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 - Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority is given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Tier 3 sources may include, but need not be limited to, the following sources:
  - The California Environmental Protection Agency (Cal EPA) Toxicity Criteria Database (Cal EPA 2008) includes toxicity values that have been peer reviewed.
  - The ATSDR Minimal Risk Levels are similar to RfDs and are peer reviewed.

- Health Effects Assessment Summary Table (HEAST) toxicity values are currently under review by the STSC to derive PPRTVs. The toxicity values remaining in HEAST are considered Tier 3 values.

Trichloroethylene cancer potency was evaluated using the geometric mid-point of the slope factor range from EPA 2001b as recommended by EPA Region 10 (EPA 2007b). Recommendations were not provided for evaluating oral exposures for noncancer endpoints for trichloroethylene.

4.4 CHEMICALS WITH SURROGATE TOXICITY VALUES

If a toxicity value was not available from the above hierarchy for a specific chemical, a structurally similar chemical was identified as a surrogate. The reference dose or slope factor for the surrogate chemical was selected as the toxicity value and the surrogate chemical was indicated in Tables 4-1 and 4-2. The following chemicals were evaluated using surrogate toxicity criteria:

- Butyltin. The toxicity of organotin compounds is somewhat determined by the nature and number of groups bound to tin. In general, toxicity decreases as the number of linear carbons increases and as the number of substitutions decrease. As a health protective approach, RfD for dibutyltin compounds was selected as a surrogate for butyltin.

- Acenaphthylene is classified as category D (not classifiable as to human carcinogenicity). The RfD for acenaphthene, which is the most structurally similar PAH, was selected as a surrogate for acenaphthylene.

- Benzo(e)pyrene. As a health protective approach, the RfD for pyrene was used as a surrogate for benzo(e)pyrene.

- Benzo(g,h,i)perylene is classified as category D (not classifiable as to human carcinogenicity). As with benzo(e)pyrene, the RfD for pyrene was used as a surrogate for benzo(g,h,i)perylene.

- Dibenzothiophene. Fluorene the most structurally similar PAH with available toxicity values. Hence, the RfD for fluorene was used as a surrogate for dibenzothiophene.

- Dibenzofuran. The RfD for flourene, which represents the most structurally similar compound for which an RfD was available was selected as a surrogate for dibenzofuran.

- Di-n-octyl phthalate. The RfD for dibutyl phthalate was selected as a surrogate for di-n-octyl phthalate.

- Perylene. The RfD for pyrene was selected as a surrogate for perylene.
- Phenanthrene. The RfD for pyrene was selected as a surrogate for phenanthrene.
- Retene. The RfD for pyrene was selected as a surrogate for retene.
- Endrin aldehyde. Endrin aldehyde can occur as an impurity of endrin or as a degradation product (ATSDR 1996). The RfD for endrin was used as a surrogate for endrin aldehyde.
- Endrin ketone. Endrin ketone can occur as an impurity of endrin or as a degradation product (ATSDR 1996). The RfD for endrin was used as a surrogate for endrin ketone.
- 4-Nitrophenol. The RfD for 4-methylphenol was used as a surrogate for 4-nitrophenol.

4.5 CHEMICALS WITHOUT TOXICITY VALUES

No SF and RfD or other suitable surrogate values were obtained for titanium and delta-hexachlorocyclohexane (delta-HCH). Titanium is a naturally occurring element and has been characterized as having extremely low toxicity (Friberg et al. 1986). An STSC review concluded that the other hexachlorocyclohexane isomers could not be used as surrogates for delta-HCH due to differences in toxicity (EPA 2002d). Accordingly, the potential risks from titanium and delta-HCH are discussed qualitatively in the uncertainty assessment in Section 6.

SFs and RfDs were not identified for lead because lead was evaluated through comparison with benchmark concentrations that are based on blood lead levels. Benchmark concentrations for child exposure scenarios were predicted by the Integrated Exposure Uptake Biokinetic (IEUBK) model. Benchmark concentrations for adult exposure scenarios were predicted by the Adult Lead Methodology (ALM). Uncertainties associated with using these benchmark concentrations are discussed in Section 6.4.4.

4.6 TOXICITY VALUES FOR CHEMICAL CLASSES

Certain toxicity values are based on exposure to more than one isomer and not to individual chemicals. As a result, the risks were evaluated for the combined exposure rather than on an individual chemical basis. COPCs that were evaluated for toxicity as classes are indicated in Tables 4-1 and 4-2, and are discussed below.

- Chlordane: The chlordane toxicity values were derived for technical chlordane, which is composed of a mixture of chlordane isomers. The chlordane isomers analyzed in Round 1, Round 2, and Round 3 samples were alpha-chlordane, *trans*-chlordane, *cis*-nonachlor, *trans*-nonachlor, and oxychlordane. These isomers were summed in a total chlordane concentration. The SF and RfD for technical chlordane were used to evaluate total chlordane.

- DDD, DDE, and DDT: Technical DDT includes 2,4'-DDT and 4,4'-DDT, as well as 2,4'-DDE, 4,4'-DDE, 2,4'-DDD, and 4,4'-DDD. Although individual slope factors are available for DDD, DDE, and DDT based on studies conducted using the 4,4' isomers, the potency of the 2,4' isomers was assumed to be equal to that of the 4,4' isomers, and cancer risks assessed as the sum of the 2,4' and 4,4' isomers. Additionally, the RfD for DDT was used as a surrogate to evaluate the noncancer effects of DDD and DDE.

- Endosulfan: The RfD for endosulfan was derived from studies using technical endosulfan, which includes alpha-endosulfan, beta-endosulfan, and endosulfan sulfate. The individual endosulfan results were summed to give a total endosulfan concentration, and the RfD for technical endosulfan was used to evaluate total endosulfan.

- PCBs: The cancer slope factor for PCBs is based on administered doses of Aroclors (Aroclor 1016, 1242, 1254, or 1260), and was used to assess the cancer risks for total PCBs measured either as congeners or Aroclors. As discussed in Section 2.2.8, total PCB concentrations were calculated as either the sum of Aroclors or individual congeners. Where PCBs were reported as individual congeners, an adjusted PCB concentration was calculated by subtracting the sum of total dioxin-like PCB congener concentrations from the sum of all congeners. Dioxin-like PCB congeners were evaluated separately using the slope factor for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) as described below. This approach may double-count a portion of the toxicity of the dioxin-like PCBs, as discussed in Section 6.3.6. The RfD for Aroclor 1254 was used to evaluate the noncancer endpoint for total PCBs, measured either as total unadjusted congeners or as Aroclors.

- Dioxins and furans: Toxic Equivalency Factors (TEFs) from the World Health Organization (WHO) (Van den Berg 2006) were used to evaluate carcinogenic effects of dioxin and furan congeners and for dioxin-like PCB congeners (see Table 4-3). Concentrations of individual congeners are multiplied by their respective TEF to provide a 2,3,7,8-TCDD-equivalant concentration (TEQ), the resulting TEQs are then summed into a total 2,3,7,8-TCDD TEQ. Cancer risk were assessed using the slope factor for 2,3,7,8-TCDD was used to evaluate the cancer endpoint of the TEQ for dioxin and furan congeners, as well as for dioxin-like PCB congeners. The ATSDR

MRL for 2,3,7,8-TCDD was used in conjunction with the TEQ approach for dioxin and furan congeners, and for dioxin-like PCB congeners.

- Carcinogenic PAHs: Individual carcinogenic PAHs were evaluated for toxicity based on their potency equivalency factor (PEF), which estimates cancer potency relative to benzo(a)pyrene (EPA 1993). The toxicity values for individual PAHs shown in Table 4-1 incorporate their respective PEFs. Risk from both individual and total carcinogenic PAHs was assessed in this BHHRA.

4.7 DERMAL ASSESSMENT

Toxicity is a function of contaminant concentration at critical sites-of-action. However, most oral reference doses and slope factors are expressed as an administered dose, whereas exposure estimates for dermal exposures are based on the absorbed dose. Anatomical differences between the gastrointestinal tract and the skin can affect rate as well as the extent of absorption. Thus, the route of exposure may significantly affect the critical dose at the site-of-action. A further complication is that an orally administered dose experiences "hepatic first-pass" metabolism, which may significantly alter the toxicity of the administered chemical. Additionally, some chemicals can cause cancer or other effects through direct action at the point of application. For such locally active compounds, it may be inappropriate to evaluate risks based on oral response data.

As recommended by EPA guidance (EPA 2004), an adjustment to the oral toxicity factor to account for the estimated absorbed dose was applied when the toxicity value derived from the critical study was based on an oral dose and GI absorption of the chemical is less than 50 percent from a medium similar to the one used in the critical study.

Dermal RfDs for assessing dermal exposure were calculated using the following equation:

$$RfD_{dermal} = RfD_o \times ABS_{GI}$$

RfD_{dermal} = dermal reference dose (mg/kg-day)
RfD_o = oral reference dose (mg/kg-day)
ABS_{GI} = fraction of contaminant absorbed in gastrointestinal tract

Cancer slope factors for assessing dermal exposure were calculated as follows:

$$SF_{dermal} = \frac{SF_o}{ABS_{GI}}$$

SF_{dermal} = dermal cancer slope factor $(mg/kg\text{-}day)^{-1}$
SF_o = oral cancer slope factor $(mg/kg\text{-}day)^{-1}$

ABS_{GI} = fraction of contaminant absorbed in gastrointestinal tract

5.0 RISK CHARACTERIZATION

Risk characterization integrates the information from the exposure assessment and toxicity assessment, using a combination of qualitative and quantitative information to provide numerical estimates of potential adverse health effects. Risk characterization is performed separately for carcinogenic and noncarcinogenic effects. Carcinogenic risk is expressed as the probability that an individual will develop cancer over a lifetime as a result of exposure to a potential carcinogen. Noncarcinogenic hazards are evaluated by comparing an estimated exposure level or dose with a reference dose that is without appreciable risk of adverse health effects.

5.1 RISK CHARACTERIZATION METHODOLOGY

This section describes how noncancer hazards and cancer risks were estimated in this BHHRA.

5.1.1 Noncancer Hazard Estimates

The potential for adverse noncancer health effects is generally addressed by comparing the CDI to the corresponding RfD to yield a hazard quotient (HQ; EPA 1989):

$$HQ = \frac{CDI}{RfD}$$

The calculation of a HQ assumes that exposures less than the RfD are unlikely to result in adverse health effects, even for sensitive populations. By definition, when the HQ is less than 1, the estimated exposure is less than the RfD and adverse health effects are unlikely. Unlike cancer risks, the HQ does not represent a statistical probability, and the likelihood of adverse effects does not increase in a linear fashion relative to a HQ of 1. Rather, exposures greater than the RfD may result in adverse health effects, but all RfDs do not have equal precision and are not based on the same severity of effects. HQs for individual chemicals were summed to yield a cumulative hazard index (HI). Although a HI provides an overall indication of the potential for noncancer hazards, dose additivity is most appropriately applied to chemicals that induce the same effect via the same mechanism of action. When the HI is greater than 1 due the sum of several HQs of similar value, it is appropriate to segregate the chemical-specific HQs by effect and mechanism of action. In this BHHRA, when the calculated HI was greater than 1, HQs based on the same target organ system were calculated. The target organs or systems on which the RfDs are based are presented in Table 5-1.

5.1.2 Cancer Risk Estimates

The cancer slope factor converts the estimated daily intakes averaged over a lifetime directly to an incremental cancer risk. Cancer risks are calculated by multiplying the estimated LADI of a carcinogen by the SF (EPA 1989):

$$Risk = LADI \times SF$$

The dose-response relationship is generally assumed to be linear through the low-dose portion of the dose-response curve. That is, the risk of developing cancer is assumed to be directly associated with the amount of exposure. However, this linear relationship is valid only when the estimated risk is less than 0.01 (1 x 10^{-2}). Where contaminant concentrations result in an estimated risk greater than 1 x 10^{-2}, the following equation was used (EPA, 1989):

$$Risk = 1\text{-}e^{-LADI \times SF}$$

Because the slope factor typically represents an upper confidence limit, carcinogenic risk estimates generally represent an upper-bound estimate, and EPA is confident that the true risk will not be greater than risk estimates obtained using this model, and they may be less than that predicted. Cancer risk estimates for individual chemicals and different exposure pathways were summed where exposure was assumed to be concurrent to obtain the cumulative excess lifetime cancer risk for each receptor and/or exposure scenario.

5.1.3 Infant Consumption of Human Milk

As discussed in Section 3.3.7, infant exposure to persistent, lipophilic contaminants via breastfeed was quantitatively evaluated in the BHHRA. Using the methodology presented in Section 3.5.5, DEQ determined that the magnitude of the difference in the risk and hazard estimates between the infant and the mother remain constant regardless of the maternal exposure pathway or dose, and can be expressed as infant risk adjustment factors (IRAFs, DEQ 2010):

$$Risk_{infant} = Risk_{mother} \times IRAF_{ca}$$

$$HQ_{infant} = HQ_{mother} \times IRAF_{nc}$$

where:

HQ_{infant} = hazard quotient for breast-fed infant
HI_{mother} = hazard quotient for the mother
$Risk_{infant}$ = cancer risks to breast-fed infant
$Risk_{mother}$ = cancer risks to the mother
$IRAF_{ca}$ = infant risk adjustment factor for carcinogenic effects
$IRAF_{nc}$ = infant risk adjustment factor for noncancer effects

Where combined child and adult exposures were evaluated, the combined child/adult risks were used as the maternal cancer risk for assessing risks to infants. The chemical-specific IRAFs are presented in the following table:

Chemical	$IRAF_{ca}$	$IRAF_{nc}$
PCBs	1	25
Dioxins/Furans	1	2
DDx	0.007	2
PBDEs	1	2

5.1.4 Risk Characterization for Lead

Health effects associated with exposure to inorganic lead and compounds are well documented and include neurotoxicity, developmental delays, hypertension, impaired hearing acuity, impaired hemoglobin synthesis, and male reproductive impairment. Importantly, many of lead's health effects may occur without other overt signs of toxicity. Lead has particularly significant effects in children, and it appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. Because of the difficulty in accounting for pre-existing body burdens of lead and the apparent lack of threshold, EPA determined that it was inappropriate to develop a RfD. The Centers for Disease Control (CDC) has identified a blood lead concentration of 10 micrograms per deciliter (µg/dL) as the level of concern above which significant health effects may occur (CDC 1991), and the concentration of lead in the blood is used as an index of the total dose of lead regardless of the route of exposure (EPA 1994). An acceptable risk is generally defined as a less than 5 percent probability of exceeding a blood lead concentration of 10 µg/dL (EPA 1998).

Using the ALM (EPA 2003c), acceptable lead concentrations in fish tissue that are unlikely to result in fetal blood lead concentrations greater than 10 µg/dL were calculated using the following equation:

$$PbF = \frac{\left(\left[PbB_f / R \times GSD^{1.645}\right] - PbB_o\right) \times AT}{BKSF \times \left(IR_F \times AF_F \times EF_F\right)}$$

Where:

PbB_a	=	Central tendency of adult blood lead level
PbB_o	=	Adult baseline blood lead level
PbB_f	=	Fetal blood lead level
R	=	Fetal/maternal blood lead ratio
GSD	=	Geometric standard deviation PbB
BKSF	=	Biokinetic slope factor

PbF = Lead fish tissue concentration
IR_F = Consumption rate of fish
AF_F = Gastrointestinal absorption of lead from fish
EF_F = Exposure frequency for fish consumption
AT = Averaging time

The values used in this analysis are presented in Attachment F5. Because the lead models calculate a central tendency or geometric mean blood lead concentration, median values are typically used as inputs. The mean estimate of national per capita fish consumption of 7.5 g/day (EPA 2000b) was used as the consumption rate for recreational fishers, the median consumption rate of 39.2 g/day from the CRITFC study was used for tribal fishers. Using the equation presented above, the target lead concentrations in fish are 5.2 mg/kg for recreational fishers and 1 mg/kg for tribal fishers.

EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model was used to calculate tissue lead concentrations unlikely to result in blood lead concentrations greater than 10 µg/dL in children. Because site-specific values for concentration of lead in soil, house dust, air and drinking water were not readily available, default values were used for those inputs. The ratio of child-to-adult consumption of 0.42 was applied to the median adult consumption rate of 7.5 g/day to obtain a childhood rate of 3.2 g/day for children of recreational fishers. The corresponding lead concentration in fish is 2.6 mg/kg. Assuming a consumption rate of 16.2 g/day for tribal children, representing the 65^{th} percentile consumption rate from the CRITFC survey, the calculated lead concentration in fish is 0.5 mg/kg. Uncertainties associated with the evaluation of lead are discussed further in Section 6.

5.1.5 Cumulative Risk Estimates for Contaminants Analyzed by More Than One Method

In some instances specific contaminants were analyzed by more than one method, and thus more than one EPC calculated for that contaminant. Cumulative risks are presented using the EPC from only one method to avoid double-counting the risks from a given contaminant. When assessing risks associated with sediment exposures, Aroclor data was used because the data set was larger than for congeners. However, because the congener analysis provided lower detection limits, it was preferentially used when available for assessing risks associated with consumption of fish and shellfish. Where metals were analyzed as both total and dissolved fractions in surface water and groundwater seep samples, the EPCs based on total metals were used in the cumulative risk estimates because unfiltered data is generally more representative of typical human exposure.

5.2 RISK CHARACTERIZATION RESULTS

This section presents a summary of the risk characterization results the scenarios described in Section 3. EPA policy (EPA 1991a) states that CERCLA actions are generally warranted when where the baseline risk assessment indicates that a cumulative site risk to an individual using RME assumptions for either current or future land use is greater than the 1 x 10^{-4} lifetime excess cancer risk end of the cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}, or the HI is greater than 1. Accordingly, risk and hazard estimates are generally presented in terms of whether they are greater than the upper end of the cancer risk range of 1 x 10^{-4} or the HI is greater than 1. Uncertainties associated with the assumptions in each exposure scenario are discussed in detail in Section 6. Risks from exposures to PBDEs in in-water sediment and tissue were assessed separately, and are presented in Attachment F3.

5.2.1 Dockside Workers

Risks to dockside workers were estimated separately for each of the eight beaches designated as a potential dockside worker use areas, shown in Map 2-1.

The estimated CT and RME cancer risks are less than 1 x 10^{-4} at all beach areas, and the HI is less than 1 for adults and infants.

5.2.2 In-Water Workers

As discussed in Section 3.2.1.2, in-water workers are described as typically working around in-water structures such as docks, and primarily exposed to in-water sediments. In-water sediment exposure by in-water workers was evaluated in half-mile increments along each side of the river. The estimated CT and RME cancer risks are less than 1 x 10^{-4} at all RM segments, and the RME HIs for adults are less than 1 at any location. The HI for infants is 2 at RM 7W, and dioxin and furans are the primary contributors to the estimate. These results are presented in Tables 5-21, 5-22, 5-34 and 5-35.

5.2.3 Transients

Risks to transients were estimated separately for each beach designated as a potential transient use area, as well as the use of surface water as a source of drinking water and for bathing. Beaches where sediment exposure was evaluated are shown on Map 2-1. Year-round exposure to surface water for four individual transect stations, Willamette Cove, Multnomah Channel, and for the four transects grouped together to represent Study Area-wide exposure are shown on Map 2-3. The CT and RME risk estimates for beach sediment are less than 1 x 10^{-4} for all locations, and the HI is less than 1. The results of the RME and CT evaluations for exposure to beach sediments are presented in Tables 5-4 and 5-5, respectively.

Estimated CT and RME cancer risks associated with surface water exposures are less than 1 x 10^{-4} at all individual and transect locations, and the HI is less than 1. The results of the RME and CT evaluations are presented in Tables 5-46 and 5-47, respectively.

As noted in Section 3.3.4, exposure to surface water by transients was also evaluated at the groundwater seep at Outfall 22B. All risk and hazard estimates are less than 1×10^{-4} and 1, respectively, and the results are presented in Tables 5-64 and 5-65.

5.2.4 Divers

Commercial divers were evaluated for exposure to surface water and in-water sediment, and assuming the diver was wearing either a wet or a dry suit. As described in Section 3.4.2, in-water sediment exposure by divers is evaluated in half-mile exposure areas for each side of the river, and on a Study Area wide basis. Risks associated with exposure to surface water were evaluated for four individual transect stations, and at single-point sampling stations grouped together in one-half mile increments per side of river.

5.2.4.1 Diver in Wet Suit

The estimated CT and RME cancer risk associated with exposure to in-water sediments is less than 1×10^{-4} at all half-mile river segments and for Study Area-wide exposure, and the HI is also less than 1 for adults. The HI for infants is 2 at RM 8.5W for the RME evaluation, and PCBs are the primary contributor to the hazard estimate. The RME and CT estimates for adults are presented in Tables 5-31 and 5-32, respectively. RME and CT risk and hazard estimates for infant exposures are presented in Tables 5-42 and 5-43, respectively.

The estimated CT and RME cancer risk associated with exposure to surface water is less than 1×10^{-4} for all half-mile river segments, and the HI is less than 1. These results are presented in Tables 5-54 and 5-55, respectively, for the RME and CT evaluations. Indirect exposure to contaminants in surface water by infants via breastfeeding was not evaluated.

5.2.4.2 Diver in Dry Suit

The estimated RME cancer risk is less than 1×10^{-4} at all half-mile river segments and for Study Area-wide exposure, and the HI is also less than 1 for adults and infants. The results of the adult RME risk and hazard estimates are presented in Table 5-33, a CT evaluation was not done for a commercial diver in a dry suit.

The estimated RME cancer risk associated with exposure to surface water is less than 1×10^{-4} for all half-mile river segments, and the HI is less than 1. These results are presented in Tables 5-56. Indirect exposure to contaminants in surface water by infants via breastfeeding was not evaluated.

5.2.5 Recreational Beach Users

Risks associated with exposure to beach sediment were evaluated separately for each beach designated as a potential recreational use area, shown on Map 2-1. Exposure to surface water was evaluated using data collected from three transect locations and three single-point locations (Cathedral Park, Willamette Cove, and Swan Island Lagoon) shown on Map 2-3.

The estimated CT and RME cancer risks associated with exposure to beach sediments are less than 1 x 10^{-4} at all recreational beach areas, and the HI is also less than 1. These results are presented in Tables 5-6 through 5-11. Indirect exposure to contaminants in beach sediment to infants via breastfeeding was not evaluated.

The results of the risk evaluation for exposure to surface water by recreational beach user are presented in Tables 5-48 through 5-53. The estimated CT and RME cancer risks associated with exposure to surface water are less than 1 x 10^{-4} at all recreational beach areas, and the HI is also less than 1. These results are presented in Tables 5-50 through 5-53.

5.2.6 Recreational/Subsistence Fishers

Recreational and subsistence fishers were evaluated assuming direct exposure to contaminants in sediment and via consumption of fish and shellfish. As discussed in Section 3.2.1.6, exposures associated with beach sediment were assessed at individual beaches designated as potential transient or recreational use areas, in-water sediment exposures were evaluated on a one-half river mile basis per side of the river and as an averaged, Study Area-wide evaluation. Sediment exposures were further assessed as CT and RME evaluations and assuming either a low- or a high-frequency rate of fishing.

5.2.6.1 Sediment-Direct Contact

The estimated CT and RME cancer risks associated with low-frequency fishing exposures to either beach or in-water sediments are less than 1 x 10^{-4} at all areas evaluated. Noncancer hazards associated with adult exposures to beach or in-water sediment are less than 1 at all locations evaluated, the noncancer hazard associated with indirect exposures to infants via breastfeeding is greater than 1 at two locations for in-water sediment: RM 7W (2), where dioxin/furan TEQ concentrations are the primary contributor, and RM 8.5W (2), where PCBs are the primary contributor, with a HQ of 1. These results are presented in Tables 5-16 and 5-17 for beach sediment exposures, and Tables 5-29 and 5-30 for in-water sediment exposures.

The estimated CT and RME cancer risks associated with high-frequency fishing exposures to either beach or in-water sediments are less than 1 x 10^{-4} at all areas evaluated. For beach sediment, noncancer hazards associated with adult exposure are less than 1 at all locations evaluated. Noncancer hazards associated with adult exposures to in-water sediment are greater than 1 at RM 7W (2), with dioxin/furan TEQ concentrations as the primary contributor the noncancer hazard. The noncancer hazard associated with indirect exposures to infants via breastfeeding is also greater than 1 at RM 7W (3), where dioxin/furan TEQ concentrations are the primary contributor, and RM 8.5W (2), where PCBs are the primary contributor with a HQ of 2. These results are presented in Tables 5-14 and 5-15 for beach sediment exposures, and Tables 5-26 through 5-28 for in-water sediment exposures.

5.2.6.2 Consumption of Smallmouth Bass

Consumption of both whole body and fillet-only smallmouth bass was evaluated on a river mile basis to account for their relatively small home range. An additional analysis averaging consumption over the entire Study Area was also conducted. The estimated CT and RME cancer risks associated with combined child and adult consumption of whole body smallmouth bass are greater than 1 x 10^{-4} for all river miles evaluated, and RME cancer risk estimates are greater than 1 x 10^{-3} for each river mile. CT cancer risk estimates are greater than 1 x 10^{-3} at RM 7, RM 11, and at Swan Island Lagoon. Study Area-wide RME risks for recreational and subsistence fishers are 7 x 10^{-3} and 4 x 10^{-3}, the CT estimate for recreational fishers is 9 x 10^{-4}. Values for river miles having the highest estimated RME risks are as follows (for recreational and subsistence fishers, respectively): RM 7 (6 x 10^{-3} and 1 x 10^{-2}), Swan Island Lagoon (6 x 10^{-3} and 1 x 10^{-2}), and RM 11 (1 x 10^{-2} and 2 x 10^{-2}). Dioxins/furans, PCBs and DDx are the primary contributors to the overall risk at RM 7; PCBs, and to a lesser degree dioxins/furans, are the primary contributors in Swan Island Lagoon and at RM 11.

RME risk estimates for fillet-only consumption are all greater than 1 x 10^{-4}, the CT estimate is greater than 1 x 10^{-4} at RM 7 and RM 11. Study Area-wide RME risks for recreational and subsistence fishers are 9 x 10^{-4} and 2 x 10^{-3}, the CT estimate for recreational fishers is 2 x 10^{-4}. River miles having the highest estimated risks are (for recreational and subsistence fishers, respectively): RM 7 (9 x 10^{-4} and 2 x 10^{-3}) and RM 11 (2 x 10^{-3} and 3 x 10^{-3}), fillet-only data were not collected in Swan Island Lagoon. Dioxins/furans and PCBs are the primary contributors to the overall risk as RM 7, PCBs, and to a lesser degree dioxins/furans, are the primary contributors in Swan Island Lagoon and at RM 11. These results are presented in Table 5-114.

RME noncancer hazards associated with childhood consumption of whole body smallmouth bass are greater than 1 at all river miles evaluated. Areas with the highest estimated hazard display a pattern similar to those with highest cancer risks. Values for river miles having the highest estimated hazard are as follows (for recreational and subsistence fishers, respectively): RM 7 (300 and 600), Swan Island Lagoon (500 and 1,000), and RM 11 (700 and 1,000). The highest values for the CT noncancer hazard estimates for recreational fishers are 70 (RM 7), 200 (RM 11), and 100 (Swan Island Lagoon). Study Area-wide RME hazards for recreational and subsistence fishers are 200 and 500, respectively, the CT estimate for recreational fishers is 60.

Dioxins/furans and PCBs are the primary contributors at RM 7, while PCBs are predominantly the contributor in Swan Island Lagoon and at RM 11.

RME hazard estimates for fillet-only consumption are also greater than 1 at all river miles. Values for river miles having the highest estimated RME hazard for fillet-only consumption are as follows (for recreational and subsistence fishers, respectively): RM 7 (50 and 90), and RM 11 (100 and 300); fillet-only data were not collected in Swan Island Lagoon. Study Area-wide RME hazards for recreational and subsistence fishers are 70 and 100, respectively, the CT estimate for recreational fishers is 20. PCBs and dioxin/furans are the primary contributors to the hazard estimates at RM 7 while PCBs are the primary contributor to the hazard estimate at RM 11. These results are presented in Table 5-94.

RME and CT noncancer hazard associated with indirect exposure to infants via breastfeeding was also assessed. Values for river miles having the highest estimated RME hazard due to consumption of whole body smallmouth bass are as follows (for infant children of recreational and subsistence fishers, respectively): RM 7 (3,000 and 5,000), Swan Island Lagoon (6,000 and 10,000), and RM 11 (8,000 and 20,000). The associated CT estimates for recreation fishers are 600 at RM 7, 1,000 at Swan Island Lagoon, and 2,000 at RM 11. The RME hazard estimates associated with fillet-only consumption are: RM 7 (300 and 600), and RM 11 (2,000 and 4,000), fillet-only data were not collected in Swan Island Lagoon. The comparable CT estimates for recreational fishers are 70 at RM 7, and 500 at RM 11. PCBs are the primary contributors to the estimated noncancer hazard estimates. These results are presented in Table 5-119.

5.2.6.3 Consumption of Common Carp

Consumption of common carp was evaluated assuming fish were caught from one of five overlapping fishing zones described in Section 3.4.5, as well as on a Harbor-wide basis. The estimated RME cancer risks associated with combined child and adult consumption of whole body common carp are greater than 1×10^{-4} in each fishing zone evaluated. Values for fishing zones having the highest estimated risks are as follows (RME estimates for recreational and subsistence fishers, respectively): FZ 3-6 (1×10^{-2} and 2×10^{-2}), FZ 4-8 (3×10^{-2} and 7×10^{-2}, and FZ 8-12 (2×10^{-3} and 5×10^{-3}). The Study Area-wide risk estimates are 4×10^{-2} and 2×10^{-2}. CT estimates for recreational fishers are greater than 1×10^{-4} in all fishing zones, and is 5×10^{-3} when evaluated Study Area-wide. PCBs, dioxins/furans, and DDx are the primary contributors to the estimated risks assuming whole body consumption; dioxins/furans were not analyzed in fillet samples collected from FZs 3-6 and 6-9.

The RME risk estimates for fillet-only consumption (for recreational and subsistence fishers, respectively) are: FZ 3-6 (1×10^{-3} and 2×10^{-3}), FZ 4-8 (2×10^{-2} and 4×10^{-2}, and FZ 8-12 (1×10^{-3} and 2×10^{-3}). The Study Area-wide RME risk estimates are 4×10^{-2} and 2×10^{-2}. The CT estimate for recreational fishers is 1×10^{-4} in FZ 0-4, all other CT estimates are greater than 1 x 10^{-4}. These results are presented in Table 5-115.

RME noncancer hazards associated with childhood consumption of whole body common carp are greater than 1 in each fishing zone evaluated. Values for fishing zones having the highest estimated hazard are as follows (RME estimates for recreational and subsistence fishers, respectively): FZ 3-6 (900 and 2,000) and FZ 4-8 (3,000 and 5,000). The Study Area-wide estimates are 2,000 and 4,000. The associated CT estimates for recreational fishers is 200 at FZ 3-6, 600 in FZ 4-8, and 500 Study Area-wide. The comparable hazard estimates for fillet-only consumption are: FZ 3-6 (200 and 100), FZ 4-8 (4,000 and 2,000), and 500 Study Area-wide. CT estimates for recreational fishers are 30 in FZ 3-6, 500 in FZ 4-8, and 500 Study Area-wide. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-98

RME noncancer hazards associated with indirect exposure to infants via breastfeeding are greater than 100 in each fishing zone evaluated. Values for fishing zones having the highest estimated hazard are as follows (infant children of recreational and subsistence fishers, respectively): FZ 3-6 (10,000 and 20,000) and FZ 4-8 (30,000 and 60,000); Study Area-wide estimates are 30,000 and 50,000, respectively. The comparable CT estimates for infants of recreational fishers are 3,000 in FZ 3-6, 8,000 in FZ 4-8, and 6,000 Study Area-wide.

RME hazard estimates associated with fillet-only consumption are (for infants of recreational and subsistence fishers, respectively): FZ 3-6 (1,000 and 3,000), FZ 4-8 (30,000 and 50,000); the Study Area-wide estimates are 30,000 and 50,000. CT estimates for infants of recreational fishers are 400 in FZ 3-6, 6,000 at FZ 4-8, and 6,000 Study Area-wide. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-120.

5.2.6.4 Consumption of Brown Bullhead

Data from brown bullhead was combined across two fishing zones, encompassing RMs 3-6 and 6-9, was well as combining these data to provide a Study Area wide assessment. The RME estimates assuming whole body consumption are (for recreational and subsistence fishers, respectively) are 6 x 10^{-4} and 1 x 10^{-3} in FZ 3-6, 6 x 10^{-4} and 4 x 10^{-3} in FZ 6-9, and 2 x 10^{-3} and 4 x 10^{-3} Study Area-wide. The associated CT estimates for recreational fishers are 2 x 10^{-4} in FZ 3-6, 6 x 10^{-4} in FZ 6-9, and 5 x 10^{-4} Study Area wide.

RME risk estimates for recreational and subsistence fishers, respectively, assuming fillet-only consumption are 7 x 10^{-5} and 1 x 10^{-4} in FZ 3-6, and 1 x 10^{-3} and 2 x 10^{-3} in FZ 6-9. The Study Area-wide risk estimates are 1 x 10^{-3} and 2 x 10^{-3}. The associated CT estimates for recreational fishers are 2 x 10^{-5} in FZ 3-6, 3 x 10^{-4} in FZ 6-9, and 3 x 10^{-4} Study Area wide. These results are presented in Table 5-116.

RME noncancer hazards associated with childhood consumption of whole body brown bullhead are greater than 1 in all instances. The RME estimates for recreational and subsistence fishers, respectively, are 40 and 70 in FZ 3-6, 200 and 400 in FZ 6-9, and 200 and 300 Study Area-wide. CT estimates for recreational fishers are 8 in FZ 3-6, 50 in FZ 6-9, and 40 Study Area-wide.

RME hazard estimates assuming fillet-only consumption are 7 and 10 in FZ 3-6, 100 and 300 in FZ 6-9, and 100 and 300 Study Area-wide. CT estimates for recreational fishers assuming fillet-only consumption are 2 at FZ 3-6, 30 at FZ 6-9, and 30 Study Area-wide. These results are presented in Table 5-102.

Assuming whole body consumption of brown bullhead, the RME noncancer hazards associated with indirect exposure to infant children of recreational and subsistence fishers, respectively, via breastfeeding are 300 and 600 in FZ 3-6, 2,000 and 5,000 in FZ 6-9, and 2,000 and 4,000 Study Area-wide. CT estimates for infants of recreational fishers are 70 at FZ 3-6, 600 at FZ 6-9, and 500 Study Area-wide. The RME hazard estimates assuming parental fillet-only consumption are 70 and 100 in FZ 3-6, 2,000 and 3,000 in FZ 6-9, and 2,000 and 3,000 Study Area-wide. CT estimates for infants of recreational fishers are 20 at FZ 3-6, 400 at FZ 6-9, and 400 Study Area-wide. These results are presented in Table 5-121.

5.2.6.5 Consumption of Black Crappie

Data from black crappie was also combined across two fishing zones, encompassing RMs 3-6 and 6-9, was well as combining these data to provide a Study Area wide assessment. RME estimates assuming whole body consumption for recreational and subsistence fishers, respectively, are 3 x 10^{-4} and 6 x 10^{-4} in FZ 3-6, 6 x 10^{-4} and 1 x 10^{-3} in FZ 6-9, and 6 x 10^{4} and 1 x 10^{-3} Study Area-wide. The comparable CT estimates for recreational fishers are 9 x 10^{-5} in FZ 3-6, 2 x 10^{-4} in FZ 6-9, and 2 x 10^{4} Study Area-wide.

RME risk estimates assuming fillet-only consumption are 3 x 10^{-5} and 6 x 10^{-5} at FZ 3-6, 4 x 10^{-5} and 8 x 10^{-5} in FZ 6-9, and 4 x 10^{-5} and 8 x 10^{-5}. CT estimates for recreational fishers are 9 x 10^{-6} in FZ 3-6, 1 x 10^{-5} in FZ 6-9, and 1 x 10^{-5} Study Area-wide These results are presented in Table 5-117.

RME noncancer hazards associated with childhood consumption of whole body black crappie are greater than 1 in all instances. The RME estimates for recreational and subsistence fishers, respectively, are 20 and 40 in FZ 3-6, 40 and 80 in FZ 6-9, and 40 and 80 Study Area-wide. CT estimates for recreational fishers are 8 in FZ 3-6, 50 in FZ 6-9, and 40 Study Area-wide.

RME hazard estimates assuming childhood fillet-only consumption for recreational and subsistence fishers, respectively, are 4 and 8 at FZ 3-6, and 6 and 10 at FZ-6-9. The associated Study Area-wide risk estimates assuming fillet-only consumption are 6 and 10. CT estimates for recreational fishers assuming fillet-only consumption are 2 in FZ 3-6, 30 in FZ 6-9, and 30 Study Area-wide. These results are presented in Table 5-102.

Assuming adult whole body consumption of black crappie, the RME noncancer hazards associated with indirect exposure infants to infant children of recreational and subsistence fishers, respectively, via breastfeeding are 100 and 300 at FZ 3-6, 400 and 700 at FZ 6-9, and 400 and 700 Study Area-wide. CT estimates for infants of recreational fishers assuming fillet-only consumption are 70 in FZ 3-6, 600 in FZ 6-9, and 500 Study Area-wide.

RME hazard estimates for infants of recreational and subsistence fishers, respectively, assuming parental fillet-only consumption are 30 and 60 at FZ 3-6, and 40 and 80 at FZ 6-9. The associated Study Area-wide risk estimates assuming fillet-only consumption are 40 and 80. These results are presented in Table 5-121.

5.2.6.6 Multi-Species Diet

A multi-species diet, comprised of equal proportions of each of smallmouth bass, common carp, brown bullhead, and black crappie was evaluated on a harbor-wide basis. The estimated recreational fisher CT and RME cancer risk estimates for combined child and adult consumption of whole body fish are 2×10^{-3} and 7×10^{-3}, respectively, and the estimated risk for subsistence fishers is 1×10^{-2}. The corresponding CT and RME risk estimates for recreational fishers based on fillet-only consumption are 1×10^{-3} and 6×10^{-3}, respectively. The estimated risk for subsistence fishers is 1×10^{-2}. PCBs and dioxins/furans are the primary contributor to the risk estimates. These results are presented in Table 5-118.

The RME noncancer hazard estimates for childhood consumption of whole body fish for recreational and subsistence fishers are 600 and 1,000, respectively. The associated RME estimates for fillet-only consumption are 500 and 1,000, respectively. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-110.

The RME noncancer hazard estimates for indirect exposure by infants via breastfeeding assuming maternal consumption of whole body fish are 8,000 for recreational fishing and 10,000 for subsistence fishing. The associated RME estimates associated with maternal fillet-only consumption are 7,000 for recreational fishing and 1,000 for subsistence. PCBs are the primary contributors to the hazard estimates. These results are presented in Table 5-123

5.2.6.7 Consumption of Clams

The estimated RME cancer risks associated consumption of undepurated clams by subsistence fishers are greater than 1×10^{-4} at 10 of the 22 river mile sections evaluated. Values for river miles having the highest estimated risks are as follows: RM 5W (6×10^{-4}), RM 6E (7×10^{-4}), and RM 6W (7×10^{-4}). Other areas where the estimated risk is equal to or greater than 1 x 10^{-4} are RM 2E, 3E, 4E, 4W, 7W, 8W, Swan Island Lagoon, 9W, and 11E. The estimated risk Study Area-wide is 4 x 10^{-4}. Carcinogenic PAHs and PCBs are generally the primary contributors to the overall risk, cPAHs are the primary contributors to the risk estimates at RMs 5W and 6W. At RM 7, PCBs and dioxins/furans are the primary contributors in Swan Island Lagoon and at RM 11. No estimated CT cancer risks associated with consumption of undepurated clams are greater than 1 x 10^{-4}. Risks were also evaluated based on consumption of depurated clams at RM 1E, RM 2W, RM 10, RM 11E, and RM 12E. None of the estimated CT or RME cancer risks are greater than 1 x 10^{-4}. These results are presented in Table 5-126.

The estimated RME noncancer hazards associated consumption of undepurated clams by subsistence fishers are greater than 1 at 20 of the 22 river mile sections evaluated. Values for river miles having the highest noncancer hazard are as follows: RM 3E (8), RM 6E (40), RM 9W (8), and RM 11E (10). The estimated noncancer hazard Study Area-wide is 9. PCBs and dioxins/furans are the primary contributors in Swan Island Lagoon, RM 5W, 6W RM 7 and at RM 11. The estimated CT hazards associated with consumption of undepurated clams is greater than 1 at RM 6E, where the HI is 7, and PCBs are the primary contributor to the hazard estimate. The estimated hazard associated with consumption of depurated clams is greater than 1 for the RME estimate at RM 11E, where the HI is 7. PCBs are the primary contributor to the estimated hazard. These results are presented in Table 5-126.

RME noncancer hazard associated with indirect exposure to infants via breastfeeding was also assessed, and the estimated hazard is greater than 1 at each river mile evaluated. Values for river miles having the highest estimated hazard due to parental consumption of clams are as follows (for infant children of subsistence fishers): RM 2E (20), RM 6E (200), and RM 11E (50). These results are presented in Table 5-132.

5.2.6.8 Consumption of Crayfish

The estimated RME cancer risks associated consumption of crayfish by subsistence fishers are greater than 1 x 10^{-4} at two of the 32 individual stations evaluated: 07R006 (3 x 10^{-4}) located at RM 7W, and CR11E (3 x 10^{-4}) located at RM 11E. When evaluated Study Area-wide, the estimated risk is 3 x 10^{-4}. Dioxins/furans are the primary contributors to the estimated risk at 07R006 and PCBs are the primary contributors at CR11E. These results are presented in Table 5-129.

The estimated RME noncancer hazards associated consumption of crayfish by subsistence fishers are greater than 1 at six of the 32 individual stations. Stations having the highest estimated hazard are 03R005 (4) located at the end of the International Slip, 07R006 (6), and CR11E (20). The estimated noncancer hazard Study Area-wide is 10. PCBs are generally the primary contributors to the noncancer hazard at 03R005 and CR11E, dioxins/furans are the primary contributors at 07R006. These results are presented in Table 5-129.

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RME noncancer hazard associated with indirect exposure to infants via breastfeeding is greater than 1 at 17 of the 32 stations evaluated. Values at locations having the highest estimated hazard due to parental consumption of clams are as follows (for infant children of subsistence fishers): 02R001 (20) at RM 2E, 03R003 (20) at RM 3E, 03R005 (60) at RM 3E, 07R006 (20) at RM 7W, 09R002 (30) at RM 9W, and CR11E (400) at RM 11E. The hazard is 200 when evaluated Study Area-wide. These results are presented in Table 5-133.

5.2.7 Tribal Fishers

Tribal fishers were evaluated assuming direct exposure to contaminants in sediment and via consumption of fish. Exposures associated with beach sediment were assessed at individual beaches, in-water sediment exposures were evaluated on a one-half river mile basis per side of the river and as an averaged, Study Area-wide evaluation. Fish consumption was evaluated assuming a multi-species diet consisting of anadromous and resident fish species, and fishing was evaluated on a Study Area-wide basis.

5.2.7.1 Sediment – Direct Contact

The estimated CT and RME cancer risks associated with direct contact to beach sediment is less than 1×10^{-4} at all beaches evaluated. The estimated RME cancer risk associated with exposure to in-water sediment is greater than 1×10^{-4} at two locations: RM 6W (2×10^{-4}) and RM 7W (3×10^{-4}). PAHs are the primary contributors to the risk estimate at RM 6W, dioxins/furans are the primary contributors at RM 7W. These results are presented in Table 5-12 and 5-13.

With the exception of in-water sediment exposure at RM 7W, the estimated non-cancer hazard is less than one at all beach and in-water locations evaluated. The estimated hazard is 3 at RM 7W, and dioxins/furans are the primary contributors to the estimate. These results are presented in Tables 5-12 and 5-13.

Noncancer RME hazard estimates associated with indirect exposure to infants via breastfeeding was evaluated assuming maternal exposure to in-water sediment. The estimated hazard is greater than 1 at 3 locations, RM 7W (5), RM 8.5 (4), and RM 11E (2). These results are presented in Table 5-40.

5.2.7.2 Fish Consumption

The estimated RME cancer risks for the combined child and adult exposure is 2×10^{-2} assuming whole body consumption, and 1×10^{-2} assuming consumption of fillets only. PCBs, and to a lesser extent dioxins/furans are the primary contributors to the overall risk estimates. These results are presented in Table 5-71.

The RME noncancer hazard associated with childhood consumption of whole body fish is 800, and is 600 assuming consumption of fillets only. PCBs, and to a lesser extent dioxins/furans, and arsenic are the primary contributors to the overall risk estimates. These results are presented in Table 5-69.

The RME noncancer hazard associated with indirect exposure of tribal infants via breastfeeding assuming maternal consumption of whole body fish is 9,000, and is 8,000 assuming maternal fillet-only consumption. PCBs are the primary contributors to the hazard estimates. These results are presented Table 5-72.

5.2.8 Domestic Water Use

Use of surface water as a source of household water for drinking and other domestic uses was evaluated using data from five transect and 15 single point sampling locations, as well as averaged over a Study Area-wide basis. The estimated cancer risk for combined child and adult exposures is greater than 1 x 10^{-4} at W031 (3 x 10^{-4}), located at RM 6W. PAHs are the primary contributor to the estimated cancer risk. However, dermal exposure is the primary pathway contributing to the risk estimate, and as described in EPA 2004, the physical-chemical properties of several PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene), place them outside of the Effective Prediction Domain used to estimate the absorbed dermal dose from water. Although PAHs are direct-acting carcinogens, the risk estimates associated with estimating dermal absorption from water have a greater degree of uncertainty than the other risk estimates presented in this BHHRA. These results are presented in Table 5-62.

The estimated noncancer hazard based on childhood exposure is equal to or greater than 1 at several sampling locations: W005 (1) at RM 4E, W023 (1) at RM 11, W027 (2) near the mouth of Multnomah Channel, and W035 (2) in Swan Island Lagoon. In all instances, MCPP is the primary contributor to the estimated hazard. These results are presented in Table 5-59.

5.3 CUMULATIVE RISK ESTIMATES

Cumulative risk and hazard estimates were calculated for those populations where concurrent exposure to more than one media was assumed to be plausible. Recreational/subsistence and tribal fishers were further evaluated on the basis of whether they were assumed to fish predominately from the shore or from a boat. Populations for which concurrent exposure to more than one media was considered for are as follows:

- Transients: Beach sediment, surface water
- Divers: In-water sediment, surface water
- Recreational beach users: Beach sediment, surface water

- Recreational fishers (beach): Beach sediment, fish tissue (fillet or whole body)
- Recreational fishers (boat): In-water sediment, fish tissue (fillet or whole body)
- Subsistence fishers (beach): Beach sediment, fish tissue (fillet or whole body), shellfish tissue
- Subsistence fishers (boat): In-water sediment, fish tissue (fillet or whole body), shellfish tissue
- Tribal fishers (beach): Beach sediment, fish tissue (fillet and whole body)
- Tribal fishers (boat): In-water sediment, fish tissue (fillet and whole body)

Cumulative risk estimates are generally presented for each one-half river mile per side of the river, and the risk estimates for specific media appropriate to each one-half mile segment were used to calculate the total risk or hazard. For example, cumulative risks for subsistence fishers who fish from a boat and consume smallmouth bass would include the risks associated with exposure to in-water sediment at the specific half-mile, shellfish collected within same half-mile and side-of-river specific segment, and smallmouth bass from the larger river mile assessment. The results of the cumulative risk estimates are presented in Table 5-xxx through 5-xxx. Chemicals that resulted in a cancer risk greater than 1 x 10^{-6} or an HQ greater than 1 under any of the exposure scenarios for any of the exposure point concentrations evaluated in this BHHRA are presented in Table 5-xxx.

5.4 SUMMARY OF RISK CHARACTERIZATION

Cancer risk and noncancer hazard from site-related contamination was characterized based on current and potential future uses at Portland Harbor, and a large number of different exposures scenarios were evaluated. Exposure to bioaccumulative contaminants (PCBs, dioxins/furans, and organochlorine pesticides, primarily DDx compounds, via consumption of resident fish consistently poses the greatest potential for human exposure to in-water contamination. In general, the risks associated with consumption of resident fish are greater by an order of magnitude or more than risks associated with exposure to sediment or surface water. The greatest non-cancer hazard estimates are associated with bioaccumulation through the food chain and exposure to infants via breastfeeding. Because the smallest scale over which fish consumption was evaluated was per river mile, the resolution of cumulative risks on a smaller scale is not informative. The highest relative cumulative risk or hazard estimates are at RM 2, RM 4, RM 7, Swan Island Lagoon, and RM 11. However, assuming exposure to sediment alone, there are no areas posing the risk greater than 10^{-4}, shellfish consumption alone poses the greatest risks at RM 3E, RM 5W, RM 6W, RM 6E, RM 7W and RM 11E.

6.0 UNCERTAINTY ANALYSIS

The presence of uncertainty is inherent in the risk assessment process, from the sampling and analysis of chemicals in environmental media to the assessment of exposure and toxicity, and risk characterization. EPA policy calls for numerical risk estimates to always be accompanied by descriptive information regarding the uncertainties of each step in the risk assessment to ensure an objective and balanced characterization of the true risks and hazards.

The term "uncertainty" is often used in risk assessment to describe what are, in reality, two conceptually different terms: uncertainty and variability. Uncertainty can be described as the lack of a precise knowledge resulting in a fundamental data gap. Variability describes the natural heterogeneity of a population. Uncertainty can sometimes be reduced or eliminated through further measurements or study. By contrast, variability is inherent in what is being observed. Although variability can be better understood, it cannot be reduced through further measurement or study, although it may be more precisely defined. However, the additional cost of further data collection may become disproportional to the reduction in uncertainty.

The risks and hazards presented are consistent with EPA's stated goal of RME representing the high end of the possible risk distribution, which is generally considered to be greater than the 90th percentile. However, these estimates are based on numerous and often conservative assumptions and, in the absence of definitive information, assumptions are used to ensure that actual sites risks are not underestimated. The cumulative effect of these assumptions can result in an analysis having an overall conservativeness greater than the individual components. Accordingly, it is important to note that the risks presented here are based on numerous conservative assumptions in order to be protective of human health and to ensure that the risks presented here are more likely to be overestimated rather than underestimated

6.1 DATA EVALUATION

As discussed in Section 2, sediment, surface water, groundwater seep, and biota data were collected during the RI. Data of confirmed quality that meet the DQOs for risk assessment were used in this BHHRA to estimate exposures. Although uncertainty is inherent in environmental sampling, the use of the EPA's DQO planning process (EPA 2000e) minimized the uncertainty associated with the data collected during the RI. A discussion of key data evaluation uncertainties is presented in the following sections.

6.1.1 Use of Target Species to Represent All Types of Biota Consumed

Because it is not practical to collect samples of every resident fish and shellfish species consumed by humans within the Study Area, as recommended by EPA guidance (2000a), target resident species were selected to represent the diet of all types likely consumed by humans. Four target species were collected to represent a diet consisting of resident fish: smallmouth bass, black crappie, common carp, and brown bullhead. Crayfish and clam tissue samples were collected to represent a diet containing locally-harvested shellfish. Factors considered in selecting the target species included likely consumption by humans, home range, the potential for bioaccumulation of COPCs, the trophic level of species, and their abundance.

PCBs generally represent the greatest contributors to the estimated risks, and detected concentrations are highest in smallmouth bass and common carp. Therefore, the use of target resident species as representative of all biota consumed is unlikely to underestimate potential risks. If non-resident species are consumed, the risks may be less, commensurate with the amount of non-resident species present in the diet.

6.1.2 Source of Chemicals for Anadromous and Wide-Ranging Fish Species

Salmon, lamprey, and sturgeon have traditionally represented a substantial portion of the fish diet of tribal members. These species likely spend a substantial portion of their lives outside of the Study Area, and thus contaminant concentrations in these species may bear little relationship to sediment concentrations in the Study Area.

The Washington Department of Ecology analyzed returning fall Chinook salmon, as fillet tissue with skin, collected from three coastal rivers (the Queets, Quinault, and Chehalis Rivers) in 2004 (Ecology 2007). PCBs as Aroclors were detected at concentrations ranging from 5.0 μg/kg to 6.3 μg/kg in the Ecology study, relative to the maximum detected concentration of 20 μg/kg for salmon fillet tissue with skin collected from the Lower Willamette. The dioxin TEQ concentrations ranged from 0.09 picograms per gram (pg/g) to 0.23 pg/g in the Washington coastal rivers relative to the maximum detected concentration of 2 pg/g for salmon fillet tissue with skin collected from the Lower Willamette. A comparison of the tissue concentrations from the Ecology study and the Lower Willamette indicates that the concentration of PCBs measured as Aroclors and congeners are noticeably greater in salmon collected from the Clackamas fish hatchery relative to concentrations detected in the Ecology study. The reported concentrations of total DDT and dioxins as TEQs are generally consistent between the Ecology study and results from Portland Harbor. These results are summarized in Table 6-2. While the Chehalis River passes through some developed areas and therefore may have localized sources, both the Queets and Quinault Rivers are located almost entirely within Olympic National Forest and wilderness areas, so the potential for contribution from localized sources should be minimal. The degree to which contaminant concentrations in anadromous fish are due to exposures that occur within the Study Area is unknown. However, approximately 95 percent of the cumulative tribal fish consumption risk is due to contaminants detected in resident species, even though they only account for 50 percent of the estimated diet. As a result, while sources of bioaccumulative chemicals other than Portland Harbor may contribute to tissue concentrations in anadromous fish species, the uncertainty associated with the source of chemicals to non-resident fish species should not affect the conclusions of this BHHRA for tribal fish consumption.

6.1.3 Use of Either Whole Body or Fillet Samples to Represent Fish Consumption

Different contaminants are preferentially accumulated in different parts of an organism. Organic compounds tend to accumulate to a greater degree in tissues with a higher fat content, while heavy metals accumulate more in muscle tissues. Thus, diets consisting of different parts of the fish would result in varying levels of exposure to the consumer. The COPCs with the greatest contribution to the cumulative risk and hazard are persistent chlorinated organic compounds (PCBs, DDx, and various PCDD/PCDF congeners) that preferentially accumulate in fatty tissue. As discussed in Attachment F6, the difference in measured concentrations between fillet and whole body can be as great as a factor of 10 or more.

Based on information presented in the Columbia Slough consumption survey (Adolfson 1996), the majority of fishers surveyed consume only the fillet, which may not include skin. According to the CRITFC Survey (CRITFC 1994), tribal fish consumers are also most likely to consume the fillet. However, some individuals or groups consume other portions of the fish. Assuming a diet of whole body or fillet tissue with skin represents a conservative assumption and provides a range of risks associated with different dietary habits. Because it is unlikely that a diet consists entirely of whole body tissue, the evaluation of risks associated with consumption of only whole body tissue provides a health protective approach.

6.1.4 Use of Undepurated Tissue to Represent Clam Consumption

Only a limited number clam tissue samples (five of 22) collected in the Study Area were depurated prior to analysis. Depuration is a common practice in the preparation of clams for human consumption, although they may also be consumed undepurated. With the exception of certain metals, average chemical concentrations detected in clam tissue in the Study Area were higher in undepurated than in depurated samples. However, depurated clam tissue samples were collected from edges of the site at the northern and southern stretches, and the concentrations are shown in Tables 3-24 and 3-25. Using the concentrations from undepurated samples provides a health-protective approach to assessing risk from consumption of clams.

6.1.5 Use of Different Tissue Sample Preparation to Assess the Same Chemical

Samples of resident fish tissue from Round 1 were analyzed for mercury in fillet tissue without skin, while during Round 3, smallmouth bass and common carp samples were analyzed in fillet tissue with skin. The Round 1 and Round 3 datasets were combined for Study Area analysis. For the reasons presented in Section 6.1.3, the comparability of analytical data from fillet tissue with skin and fillet tissue without skin creates uncertainty in the BHHRA. Because mercury preferentially accumulates in muscle tissue, concentrations would be expected to be higher in the fillet tissue samples without skin. However, for smallmouth bass, mercury concentrations were generally higher in fillet tissue with skin, while in common carp mercury concentrations were generally higher in fillet tissue without skin. A comparison of mercury tissue concentrations is provided in Table 6-3. The uncertainty associated with the use of different tissue types to assess risks from mercury should not affect the conclusions of this BHHRA.

6.1.6 Exclusion of Non-Detected Chemicals Where Detection Limits Exceeded Analytical Concentration Goals

Although site-specific Analytical Concentration Goals (ACGs) were established for each media, ACGs for some chemicals were not attainable in some instances with present laboratory methods. DLs for chemicals that were analyzed but never detected were compared to the appropriate ACG for each media, and the results of that analysis are presented in Tables 6-5 through 6-7.

Chemicals that were not detected were not quantitatively evaluated in the BHHRA. If chemicals were present at concentrations above the ACGs but below the DLs, those chemicals would contribute to the estimated risk and hazard. However, given the number of chemicals that were detected at concentrations above their respective ACGs and the magnitude of difference between detected concentrations and ACGs, it is unlikely that exclusion of chemicals that were not detected would affect the conclusions of this BHHRA.

6.1.7 Removal of Non-Detected Results Greater Than the Maximum Detected Concentration for a Given Exposure Area

As discussed in Section 3.4, if the DL for non-detected result was greater than the maximum detected concentration for an exposure area, that result not included when calculating the EPC. These results are presented in tables F2-7 through F2-13. Inclusion of non-detected data greater than the maximum detected concentrations would likely have resulted in higher risk estimates in the risk characterization of the BHHRA.

6.1.8 Using N-Qualified Data

As discussed in Section 2.2.3 of the RI, data were qualified using the "N" qualifier, when the identity of the analyte is not definitive, generally a result of the presence of an analytical interference in the sample. Examples include samples analyzed for chlorinated pesticide by EPA Method 8081A, which were most commonly N-qualified as a result of analytical interference due to the presence of PCBs in the samples. These N-qualified data were used in the BHHRA for calculating EPCs in fish and/or clam tissue. The following COPCs were included based solely using N-qualified data, and had estimated cancer risks greater than 1 x 10^{-6} or HQs greater than 1:

- alpha-Hexachlorocyclohexane (fish tissue)
- beta-hexachlorocyclohexane (fish tissue)
- gamma-hexachlorocyclohexane (fish tissue)
- Heptachlor epoxide (clam tissue)

Both the identity and concentration of these contaminants in fish/clam tissue is uncertain, and they were not detected in abiotic media at levels posing risk to human health. A discussion of how EPCs and risk estimates would change for adult consumption of whole body fish tissue and shellfish tissue if N-qualified data were not included in the BHHRA dataset is presented in Attachment F6.

6.1.9 Using One-Half The Detection Limit for Non-Detect Results in Summed Analytes

When data are presented as summed values (e.g., total PCB congeners), one-half the detection limit was used as a surrogate concentration when calculating the summed value for those specific analytes reported as non-detect. Use of one-half the detection limit assumes that there is equal probability that the actual concentration in the sample may be greater or less than the surrogate value. In general, the detection limits for non-detect results were low relative to detected concentrations. In addition, by only including those contaminants that were determined to be present in a given medium, the uncertainty associated with the use of non-detect results was minimized.

6.1.10 Contaminants That Were Not Analyzed in Certain Samples

Not all fish tissue samples were analyzed for the same suite of analytes. For example, fillet samples collected in Round 1 were analyzed for PCB as Aroclors, but no analysis was done for dioxins and furans. Fillet samples of smallmouth bass and common carp collected in Round 3B were analyzed for PCB, dioxin, and furan congeners. In samples where congeners were analyzed, the risks from the total dioxin TEQ, which is not otherwise measured, comprise approximately 1 to 70 percent of the cumulative risks. Therefore, the risks from consumption of black crappie and brown bullhead fillet tissue, which were only analyzed in Round 1, likely underestimate the actual risks particularly in those areas where PCBs and dioxin/furans are the predominant contaminants.

In addition, not all clam samples were analyzed for the same number of contaminants due to limited tissue mass of some composites collected during Round 2. Table 6-8 presents a listing of analyses not completed for specific samples. Additional samples were collected in Round 3B and analyzed for a greater number of specific contaminants. The Round 2 and Round 3B clam tissue data were combined and evaluated on a river-mile basis in the BHHRA. Therefore, EPCs were available for almost all COPCs in each exposure area.

6.1.11 Chemicals That Were Not Included as Analytes

As it is not practical to analyze for every chemical, specific chemicals and chemical groups were chosen for analysis based on an investigation of known or probable sources at in the LWR. However, the chemicals expected to have the potential for significant contributions to risk are included in the risk assessment. The list of chemicals for analysis was determined in collaboration with EPA and its partners and presented in the approved sampling and analysis plan. Subsequently, there has been interest in two additional groups of chemicals: polybrominated diphenyl ethers (PBDEs) and volatile organic compounds (VOCs) in tissue. Risks have subsequently been assessed for exposures to PBDEs in in-water sediment and resident fish tissue, as presented in Attachment F3.

VOCs were not analyzed in tissue or surface water samples. Because of their nature, VOCs are not expected to accumulate in tissue to a sufficient degree to pose significant risk via consumption relative to the other chemicals detected in tissue. Given the magnitude of concentrations and toxicities of other chemicals that were detected in surface water and tissue, VOCs are unlikely to contribute significantly to the overall risks. Therefore, the lack of analysis for VOCs is unlikely to alter the conclusions of the BHHRA.

6.1.12 Chemicals That Were Analyzed But Not Included in BHHRA

Not all detected chemicals were included in the BHHRA. The following analytes were excluded from assessment are either because there are no suspected sources, or the analyte typically only present adverse health risks at high concentrations:

- Ammonia
- Calcium
- Calcium carbonate
- Carbon dioxide
- Chloride
- Ethane
- Ethylene
- Magnesium
- Methane
- Nitrate
- Nitrite
- Oxygen
- Phosphate
- Phosphorus
- Potassium
- Silica
- Sodium
- Sulfate
- Sulfide

6.1.13 Data Not Included in BHHRA due to Collection Date

Data collected after June 2008 were not included in the BHHRA due to the completion schedule of the RI/FS. These data sets are discussed in the Portland Harbor RI Report, and include a number of in-water sediment samples. However, due to the large spatial coverage of the existing in-water sediment BHHRA dataset, this uncertainty is not expected to affect the overall conclusions of the BHHRA.

6.1.14 Compositing Methods for Biota and Beach Sediment Sampling

Compositing schemes were developed to be representative of the medium sampled and to be representative of each exposure unit. Fish were composited based on an estimate of the average home range for each species (ODFW 2005). The home ranges for common carp and brown bullhead may be as large or larger than the Study Area, the home range for bass may be larger or smaller than the one mile assumed in the BHHRA. For example, bass may only reside on one side of a river mile reach instead of throughout the one mile reach on both sides of the river. Smallmouth bass were composited on a river mile basis, while black crappie, brown bullhead, and carp were composited on a fishing zone basis. Fishing zones for brown bullhead and black crappie were from RM 3-6 and RM 6-9; fishing zones for common carp were from RM 0-4, RM 4-8 and RM 8-12. However, the compositing scheme represents only an approximation of the home ranges of the fish collected, and typically consisted of five individual fish. Replicate composite samples were collected, and risks were evaluated using both the composite samples as well as on a Study Area-wide basis. Where contaminants are evaluated on a harbor-wide basis and/or specific species are wide-ranging, this process is not likely to have an appreciable effect on the conclusions of the BHHRA. However, where samples are composited over an area larger than the actual home range of specific fish species, the result may either over- or underestimate risks, depending on the distribution of contaminant concentrations in the area over which samples are composited. For example, the highest DDx concentrations are located on the west side of the river at RM 7.5, while the EPC for smallmouth bass at that river mile combined data collected from both sides of the river.

Beach sediment was composited on a beach by beach basis, resulting in a single sample result for each exposure area. Uncertainty stems from this compositing scheme because the results of the risk evaluation are dependent on a single sample. Composite samples are generally assumed to represent the area from which the individual samples of the composite were taken, but an unrepresentative individual sample (e.g., one representing extremely localized or ephemeral contamination) used in the composite could significantly bias the composite results. The compositing scheme for beaches results in risk evaluation based on a single sample at a single point in time. If a beach was found to pose an unacceptable risk, additional samples at that beach might be warranted. However, all of the beach sediment exposure scenarios ranged from 8×10^{-9} to 9×10^{-5}, which are below or within the target risk range of 1×10^{-4} to1×10^{-6}.

6.1.15 Mislabeling of Smallmouth Bass Fish Sample

One smallmouth bass sample collected from the west side of RM 11 (LW3-SB11W-11) during the Round 3 sampling event was incorrectly recorded as LW3-SB11E-01 (RM 11 east) at the field lab. This fish became part of the final LW3-SB11E-C00B and LW3-SB11E-C00F composite samples, which are the body and fillet composites from RM 11 east. Fish SB11E-01 (actually from SB11W) accounted for 15 percent of both sample types on a mass basis. However, since smallmouth bass exposure areas were assessed on a river mile basis, the data from RM 11E and RM 11W were included in the same EPC calculations, and the effects of this uncertainty are not expected to affect the conclusions of this BHHRA.

6.2 EXPOSURE ASSESSMENT

Uncertainties that arise during the exposure assessment can typically have some of the greatest effect on risk estimates. The following subsections address uncertainties associated with exposure models, exposure scenarios, exposure factors, and EPCs used in the risk estimates.

6.2.1 Subsurface Sediment Exposure

A complete exposure pathway requires the presence of a retention or transport medium, an exposure point, and an exposure route. Subsurface sediment was not considered an exposure medium in the BHHRA because it was assumed that potential human contact with river sediment below 30 cm in depth was unlikely, or that if it does occur, the frequency and extent would be minimal. Situations which may result in human exposure to subsurface include: potential scouring, natural hydraulic events that are not well understood, future development of near-shore and upland properties, maintenance of the navigation channel, ports, and docks, placement and maintenance of cable and pipe crossings, pilings and dolphins, anchoring and spudding of vessels, and exposure to propeller wash from vessels. Due to the low potential of exposure to subsurface sediment, the estimates presented in the BHHRA are considered sufficiently representative of baseline exposures.

6.2.2 Potential Exposure Scenarios

Some of the key uncertainties associated with the exposure scenarios evaluated in the BHHRA are discussed in the following subsections.

6.2.2.1 Shellfish Consumption

A commercial crayfish fishery exists in the LWR, and crayfish landings must be reported to ODFW by water body and county. Per ODFW, the crayfish fishery in the LWR is not considered a large fishery (Grooms 2008), and no commercial crayfish landings were reported for the Willamette River in Multnomah County from 2005 to 2007. DHS had previously received information from ODFW indicating that an average of 4,300 pounds of crayfish were harvested commercially from the portion of the Willamette River within Multnomah County each of the five years from 1997-2001. In addition to this historical commercial crayfish harvesting, DHS occasionally receives calls from citizens who are interested in harvesting crayfish from local waters who are interested in fish advisory information. According to a member of the Oregon Bass and Panfish club, crayfish traps are placed in the Portland Harbor Superfund Site boundaries and collected for bait and possibly consumption (ATSDR 2006). It is not known to what extent non-commercial harvesting of crayfish occurs within the Study Area, if at all, or whether those crayfish are consumed and/or used for bait.

Evidence of current consumption of freshwater clams from Portland Harbor is limited. According to a project conducted by the Linnton Community Center (Wagner 2004), transients reportedly consume clams from the river on a limited and infrequent basis. As part of the project, conversations were conducted with transients about their consumption of fish or shellfish from the Willamette River. These conversations were not conducted by a trained individual and were not documented. Transients reported consuming various fish species, as well as crayfish and clams, and many indicated that they were in the area temporarily, move from location to location frequently, or have variable diets based on what is easily available. Assuming that clam consumption occurs, the Linnton Community Center project suggests that it does not occur on an ongoing basis within the Study Area. DEQ and EPA staff have occasionally received calls from individuals who claim to have harvested clams and are inquiring whether consumption is safe, and individuals have been observed harvesting clams from the shore in Portland. However, the predominant species found in the LWR during sampling events were Asian clams (*Corbicula*), which are an invasive, non-native species. Oregon law (OAR 635–056–0050) prohibits the possession, transportation, and sale of non-native wildlife, and the actual extent to which freshwater clams or other shellfish are currently harvested from Portland Harbor and consumed is not known.

6.2.2.2 Wet Suit Divers

Commercial diving companies in the Portland area were contacted to develop a better understanding of potential diver exposures within the Study Area. All of the diving companies that were contacted indicated that the standard of practice for commercial divers is the use of dry suits and helmets when diving in the LWR (Hutton 2008, Johns 2008, and Burch 2008). EPA Region 10 reported observing divers in wet suits and with regulators that are held with the diver's teeth within the Study Area. An evaluation was also performed of helmet diving with use of a neck dam, which allows can allow water to leak into the diving helmet. Commercial divers as recently as 2009 have been observed using techniques to don a diving helmet which increase exposure (Sheldrake personal communication with RSS, 2009, DEQ, 2008). The observed wet suit divers were performing environmental investigation and remedial activities, which are not activities evaluated as part of a commercial diver scenario. Also, it is not known whether the individuals who were observed diving in wet suits on specific occasions are diving within the Study Area on a regular basis, as they do not work for the commercial diving companies in the Portland area. Recreational diving also takes place in Portland Harbor (Oregon Public Broadcasting Think Out Loud, "Are you going to swim in that?" August 22, 2008). Therefore, including a wet suit diver scenario with associated ingestion from use of a recreational type regulator, rather than a full face mask or diving helmet, and full body dermal exposure in this BHHRA (in addition to a dry suit diver scenario) is a conservative approach.

6.2.2.3 Domestic Water Use

The evaluation of surface water as a domestic water source is based on the assumption that surface water is drawn from the Study Area. Within the Study Area, the LWR is not currently used as a domestic water source. According to the City of Portland, the primary domestic water source for Portland is the Bull Run watershed, which is supplemented by a groundwater supply from the Columbia South Shore Well Field (City of Portland 2008). In addition, the Willamette River was determined not to be a viable water source for future water demands through 2030 (City of Portland 2008). Additionally, although domestic water supply is a designated beneficial use of the Willamette River, OAR 340-041-0340 Table 340A defines the beneficial use only with adequate pretreatment. Thus, it is unlikely that individuals at households receiving water from the city would be exposed to contaminants at concentrations greater than the MCL. As presented in Section 5.2.8, cPAHs and MCPP are the only COPCs that posed an estimated cancer risk greater than 1×10^{-4} (cPAHs) or a noncancer hazard greater than 1 (MCPP). The uncertainties associated with assessing dermal exposures to dissolved PAHs are discussed further in Section 6.2.4.2. Although there is no MCL established for MCPP, the associated HQ is greater than 1 at only one of the locations evaluated, W035, located at RM 8.5, where the estimated hazard is 2.

6.2.3 Potentially Complete and Insignificant Exposure Pathways

Exposure pathways that have been determined to be potentially complete and insignificant were not evaluated further in this BHHRA. As described in Section 3.2, these exposure pathways have a "source or release from a source, an exposure point where contact can occur, and an exposure route by which contact can occur; however, the pathway is considered a negligible contributor to the overall risk." The exposure pathways identified as potentially complete and insignificant were related to Willamette River surface water exposures to populations evaluated in this BHHRA. Ingestion and dermal absorption of chemicals from surface water were quantitatively evaluated for the populations that are expected to have the most frequent contact with surface water. Surface water exposures were not evaluated were for dockside workers, in-water workers, tribal fishers, and fishers.

The BHHRA identified and evaluated the exposure pathways that were expected to result in the most significant exposure to COPCs in the Study Area. The magnitude of exposures experienced by populations for these exposure pathways are typically expected to be much greater than that expected for the exposure pathways identified as "insignificant." Thus, the assessment of risk to populations from exposure pathways that were quantitatively evaluated in this BHHRA would be adequately protective of exposed populations in the Study Area. However, the uncertainty associated with not directly evaluating exposure pathways considered insignificant could underestimate risks for the Study Area. Due to the low potential of exposure for these pathways, this uncertainty is not expected to impact the conclusions of this BHHRA.

6.2.4 Exposure Factors

Assumptions about exposure factors typically result in uncertainty in any risk assessment. As discussed previously, the scenarios evaluated are representative of exposures that could occur in the Study Area under either current or future conditions. RME and CT values were used for the exposure scenarios to help assess the overall effect that variability in each of the exposure assumptions has on the risk estimates. The range of risk estimates between these two exposure scenarios provides a measure of the uncertainty surrounding these estimates.

A range of ingestion rates for fish consumption were used to evaluate variability on the risk estimates, thus the resulting risks in this BHHRA represent a range of possible outcomes, including estimates that may be representative of the upper range of plausible exposures.

The following exposure factor uncertainties have been identified and analyzed further to determine the potential effects on the risk estimates:

6.2.4.1 Exposure Parameters for Sediment Exposure Scenarios

The parameters used in the BHHRA to evaluate beach and in-water sediment exposure used were intended to provide conservative estimates based on potential uses in the Study Area.

Beach areas that are accessible to the general public were identified as potential human use areas, even though it is not known whether recreational beach use actually occurs at these locations, and the extent to which the beach may be used and the nature of the contact with sediments is unknown. Future changes in land use may make some beach areas more- or less-accessible to the general public, which increases uncertainty about future exposure. When evaluating in-water sediment, each on-half mile river mile segment on each side of the navigation channel was considered a potential exposure area for all in-water sediment exposure scenarios, regardless of the feasibility or practicality of use of the area. Information from this approach can be used to inform the public about relative risks throughout the river and can help focus the feasibility study.

There are uncertainties associated in the selection of the exposure duration, frequency, and intake parameters used to evaluate both beach and in-water sediment exposures. These scenarios assume long-term repeated use of the same beach or one-half mile river mile segment, which may not accurately reflect actual use practices. The exposure frequencies evaluated range from 94 days/year up to 250 days/year. Default intake parameters for soil exposure were generally used; however, to account for an assumed greater moisture content of beach sediments, the dermal adherence factor used to evaluate child recreational beach exposure was 10-fold greater than the default for soil. Consistent with EPA guidance (2004), only those compounds or classes of compounds for which dermal absorption factors are available were quantitatively evaluated via dermal contact exposure. COPCs for which dermal absorption factors were not available were not quantitatively evaluated, as dermal absorption was essentially assumed to be zero. However, as the majority of COPCs were quantitatively evaluated, this uncertainty does not substantially change the conclusions of this BHHRA. Most of the uncertainties associated with the sediment exposure parameters are likely to overestimate the risks associated with direct exposure to sediment.

6.2.4.2 Exposure Parameters for Surface Water and Groundwater Seep Exposure Scenarios

Although dermal absorption of PAHs from water was quantitatively evaluated in the BHHRA, the dermal permeability coefficient (K_p) falls outside of the effective predictive domain (EPD) for a number of the PAHs, including the following:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Indeno(1,2,3-cd)pyrene
- Dibenzo(a,h)anthracene

EPA dermal assessment guidance (EPA 2004) states that "although the methodology [for predicting the absorbed dose per event] can be used to predict dermal exposures and risk to contaminants in water outside the EPD, there appears to be greater uncertainty for these contaminants." The range of uncertainty associated with the Kp value can be several orders of magnitude. For instance, the predicted Kp value recommended by EPA (2004) for benzo(a)pyrene is 0.7 centimeters per hour (cm/hr), while the range of predicted Kp values presented by EPA (2004) is 0.024 cm/hr (95 percent lower confidence level) to 20 cm/hr (95 percent upper confidence level). This uncertainty could result in over-estimation or under-estimation of risk from exposure to surface water. With the exception of arsenic, the only exceedances of 1×10^{-6} risk from surface water scenarios are the result of dermal exposure to PAHs in surface water. However, all of the surface water exposure scenarios were below or within the target risk range of 1×10^{-4} to 1×10^{-6}.

6.2.4.3 Exposure Parameters for Fish/Shellfish Consumption Scenarios

Site-specific information regarding fish consumption is not available for Portland Harbor. In the absence of specific data, fish consumption data representative from several sources was considered and selected as being representative of the general population of the greater Portland area, as well as that portion of the population that actively fishes the Lower Willamette and utilizes fish from the river as a partial source of food. However, the rates presented in the CSFII study represent per capita consumption rates rather than true long-term averaged consumption rates. Further, the large range between the percentile values is indicative of substantial variability in the underlying data. For example, consumption rates consumers are 200 g/day at the 90th percentile and 506 g/day at the 99th percentile. The consumption rate for consumers and non-consumers is approximately 18 g/day at the 90th percentile and 142 g/day at the 99th percentile. As discussed in Section 3.5.9.6, the RME consumption rate selected for recreational fishers of 73 g/day is based on data from the Columbia Slough study. That study was a creel survey, and the representativeness of the rate is dependent on several factors, including but not limited to:

- Willingness of anglers to participate
- Communication. If a substantial number of anglers consist of 1st or 2nd generation ethnic minorities, then language may be a barrier.
- Discrepancy between individuals who catch fish and those who prepare meals. Men generally fish but women generally prepare seafood and are much more familiar with the mass of seafood consumed.
- Difficulty in translating from the items inspected in an angler's basket to portion sizes and amounts consumed, since this requires assumptions about edible portions and cleaning factors.
- Lack of a random or representative sample. Interviewers can only speak with who they encounter.
- Timing and seasonality of interviews.
- Weather conditions may bias the results of any day's interviews.

In addition to the consumption rates, uncertainty also exists with respect to the relative percentage of the diet of obtained from the Study Area or within individual exposure areas versus other nearby sources of fish, and the degree to which different methods of preparation and cooking may reduce concentrations of persistent lipophilic contaminants.

Uncertainties associated with tribal consumption rates largely relate to limitations inherent in the CRTFIC consumption survey on which the consumption rates used in the BHHRA are based. These consumption rates may be biased low for tribal members because:

- Tribal members who have a traditional lifestyle (and likely a higher consumption rate) would have been unlikely to travel to the tribal offices that were used for administering the CRITFC fish consumption interviews.
- The fish consumption rates for some tribal members that were perceived as being outliers (consumption rates were too high) were dropped from the CRITFC data before the consumption rates were calculated.
- Current fish consumption rates may be suppressed and, therefore, do not reflect the potential of the higher consumption rates if fishery resources improved or if contaminant concentrations in the water body decrease.

Conversely, conservative assumptions were used with respect to exposure frequency and duration, as well as the relative contribution of fish from the Lower Willamette to the overall tribal diet. According to the CRITFC survey, none of the respondents fished the Willamette River for resident fish and at most, approximately 4 percent fished the Willamette for anadromous fish. However, future use of the site by tribal members may change if fishery resources improved.

Information regarding consumption of shellfish from the Study Area relies in part from information obtained from a community project sponsored by the Linnton Community Center, as discussed in Section 3.3.6. However, it is not known to what extent shellfish consumption actually occurs. Because site-specific shellfish consumption rates are not available, nationwide CSFII (USDA 1998) shellfish consumption data were used. As with the rates for fish consumption, these are based on per capita consumption rates from the general population. In the nationwide survey, shrimp accounted for more than 80 percent of the shellfish consumed, crayfish accounted for less than one percent of diet, and freshwater clams were not included in the nationwide survey. It is not known to what extent fishers substitute alternative local types of shellfish. However, the mean nationwide shellfish consumption rate from freshwater sources is 0.01 g/day; upper percentiles for freshwater shellfish consumption rates are not available (EPA 2002b).

The upper and lower bounds of uncertainty relating to fish and shellfish consumption is discussed in Attachment F6.

6.2.4.4 Assumptions about a Multi-Species Diet

Uncertainties exist in the assumptions about the relative composition of a multi-species diet. The non-tribal multi-species diet assumes equal proportions of all four resident fish species, the tribal multi-species diet assumed equal proportions of the four resident fish species, as well as dietary percentages of salmon, lamprey, and sturgeon derived from the CRITFC survey. Variations of these dietary assumptions would result in different risk estimates. Because the risks from consumption of the individual species that make up the multi-species diet were evaluated separately, the range of risks from fish consumption scenarios encompasses the potential variations in the multi-species diet. The range of the magnitude of these risks generally less than an order of magnitude, and is discussed further in Attachment F6. The magnitude in the difference of risk estimates based on diet composition shows that this uncertainty could result in over or under-estimation of actual risks from a multi-species diet.

6.2.5 Exposure Point Concentrations

The following uncertainties related to calculation of EPCs for this risk assessment were analyzed further to determine the potential effects on the risk estimates.

6.2.5.1 Using 5-10 Samples to Calculate the 95 percent UCL on the Mean

Data sets with fewer than 10 samples per exposure area generally provide poor estimates of the mean concentration, defined as a large difference between the sample mean and the 95 percent UCL. In general, the UCL approaches the true mean as more samples are included in the calculation of the EPC. The Study Area-wide fish tissue EPCs that were calculated as 95 percent UCL on the mean using less than 10 samples, included EPCs for whole body brown bullhead and fillet common carp (see Appendix F2). The EPCs for the individual exposure points for whole body brown bullhead and fillet common carp were up to two times higher than the Study Area-wide EPCs, as discussed in Attachment F6.

6.2.5.2 Nondetects Greater than Maximum Detected Concentrations

Consistent with EPA guidance, analytical results reported as non-detect for which the detection limit was greater than the maximum detected concentration in a given exposure area were removed from the dataset prior to calculation of the 95 percent UCL. These sample identifications, detection limits, and associated maximum concentrations are listed by media and exposure area in the tables in Attachment F2. If the actual concentrations were closer to the detection limit for surface water and in-water sediment, the risk estimates would still be less than 1×10^{-6}.

6.2.5.3 Using the Maximum Concentration to Represent Exposure

The maximum concentration was used in instances where there were either less than five detected results or fives samples for a given analyte and exposure area, including EPCs calculated to represent Study Area-wide exposure. Use of the maximum concentration to represent exposure occurred for all media, and occurred most frequently for the fish and shellfish consumption scenarios. Contaminants and exposure points for which the maximum detected concentration was used instead of a 95 percent UCL on the mean are presented in the exposure point concentration tables in Section 3. In some cases, the maximum concentration for a contaminant was anomalously high, and may not be representative of tissue concentrations resulting from exposure to CERCLA-related contamination within the Study Area.

Generally, the ratios between the maximum and minimum detected concentrations are less than 3. For in-water sediments, the ratios are less than 4. When comparisons are made within an exposure area for biota, the majority of the ratios of the 95 percent

UCL/maximum EPCs to the mean are equal to or less than 2, and the remaining ratios are less than 4. A more in-depth analysis of scenarios for which using the maximum concentration to represent exposure significantly affected the result of the risk estimate, and consequently which chemicals were designated as contaminants potentially posing unacceptable risks for a scenario, is provided in Attachment F6.

EPA's UCL guidance (EPA 2002) notes that that defaulting to the maximum observed concentration may not be protective when sample sizes are very small because the observed maximum may be smaller than the population mean.

6.2.5.4 Possible Effects of Preparation and Cooking Methods

Cooking and preparation methods of fish tissue can change the concentration of lipophilic contaminants in fish tissues; EPA (1997b) states that "cleaning and cooking techniques may reduce the levels of some chemical pollutants in the fish." PCBs tend to concentrate in fatty tissues. Trimming away fatty tissues, including the skin, may reduce the exposure to PCBs. Removing the skin can reduce PCB concentrations in raw fillet by 50 percent by (EPA 2000c). Cooking can also reduce the concentrations as much as 87 percent, depending on the method (Wilson et al. 1998). However, one study showed a net gain in PCB concentrations after cooking (EPA 2000c). The potential for reduction in PCB concentrations due to cooking is subject to a substantial degree of variability, and some consumption practices make use of whole fish, reductions in PCB concentrations were not considered quantitatively in the risk assessment.

6.2.5.5 Assumptions about Arsenic Speciation

Tissue concentrations of arsenic were reported as total arsenic, while EPA toxicity criteria are based on inorganic arsenic. A study conducted on the middle Willamette River (EVS 2000) measured composites of resident fish (largescale sucker, carp, smallmouth bass, and northern pikeminnow) from a 45-mile section of the river extending from the Willamette (River Mile 26.5) to Wheatland Ferry (River Mile 72). Total arsenic and inorganic arsenic concentrations were determined in composites of whole body, fillet with skin, and composites of that portion of the fish remaining after removing fillets. Percent inorganic arsenic ranged from 2 percent (carp) to 13.3 percent (sucker). The average percent of inorganic arsenic was 4.2 percent for the carp and 3.8 percent for the smallmouth bass. Consistent with the recommendation in the Columbia River Basin Fish Contaminant Survey (EPA 2002e), the EPC for inorganic arsenic was estimated as 10 percent of the total arsenic detected in tissue.

Inorganic arsenic in clams was found to range as high as 50 percent of total arsenic in data collected in the Lower Duwamish River. However, the Lower Duwamish is an estuarine system, while the Lower Willamette in Portland Harbor is freshwater system. Since the actual percent of arsenic that is inorganic in clam tissue from the Study Area is unknown, this results in uncertainty in the estimate of inorganic arsenic EPCs in shellfish. The clam tissue data collected from the Study Area was evaluated to determine whether a higher percentage of inorganic arsenic might have a significant effect on overall risk from the consumption of clam tissue:

- All of the arsenic concentrations in clam tissue are within a factor of 2. In addition, the arsenic concentrations in clams are normally distributed.
- Due to the narrow range of arsenic concentrations, the risks from consumption of clams are within a factor of 2 throughout the Study Area.
- If inorganic arsenic is assumed to be 50 percent of the total arsenic rather than the assumption of 10 percent used in the BHHRA, the cumulative risks from consumption of clams increase by a factor of 1.1 to 1.3. Arsenic is not the primary contributor to risks from consumption of clams.

Given all of the other uncertainties associated with risks from clam consumption, the inorganic arsenic assumption is a minor uncertainty with minimal effect on the overall risk estimates.

Although arsenic resulted in risks greater than 1×10^{-6} for some of the fish consumption scenarios, the contribution of arsenic to the cumulative risk was substantially less than that from PCBs. Therefore, the assumptions about inorganic arsenic are not likely to affect the overall conclusions of the BHHRA.

6.2.5.6 Polychlorinated Biphenyls

PCBs were analyzed as Aroclors in some media and as individual PCB congeners in others. This introduces some uncertainty when comparing cumulative risk across media. Congener analysis may provide a more accurate measure of PCBs in environmental samples than does the Aroclor analysis. Although most PCBs may have originally entered the environment as technical Aroclor mixtures, environmental processes, such as weathering and bioaccumulation, may have led to changes in the congener distributions in environmental media such that they no longer closely match the technical Aroclor mixtures used as standards in the laboratory analysis, leading to inaccuracies in quantitation.

The results for PCBs in whole body tissue samples analyzed for both PCBs as Aroclors and as individual PCB congeners were qualitatively compared to evaluate correlations associated with the use of Aroclor data. Windward (2005) analyzed fish tissue from the Lower Duwamish Waterway as PCB Aroclors and as individual PCB congeners. The PCB Aroclor data and PCB congener data were significantly correlated for both fillet and whole body tissue. It should be noted that the Lower Duwamish Waterway is not freshwater, and different species were assessed in the Lower Duwamish study compared to Portland Harbor. These correlations suggest that PCB Aroclor data may be used in the place of congener data if congener data are not available.

When available, PCB congener data were included in cumulative risk sums for tissue because differences in bioaccumulation in addition to weathering results in greater uncertainty in the PCB Aroclor analysis for tissue. However, fillet tissue collected in Round 1 was analyzed for PCB Aroclors only, Round 3 smallmouth bass and common carp samples were analyzed for PCB congeners only. Because PCB congener data are available for smallmouth bass and common carp fillet tissue, cumulative risks for exposure to fillet tissue from ingestion include only the most recent tissue data for these two species. This introduces uncertainty to the cumulative risk estimates for exposure to fillet tissue when comparing risks across all four resident species.

PCB Aroclor data were included in cumulative risk sums for sediment because the PCB Aroclor dataset is larger than the congener dataset.

PCB congener data were included in the risk evaluation for surface water because the PCB Aroclor data was derived from the results of the congener analysis for the samples used in the risk characterization of this BHHRA. Total PCB congeners did not screen in as COPCs for any surface water scenarios. If PCB Aroclor data from the surface water dataset were used in the COPC screening, PCBs would still not be considered a COPC for any surface water scenarios.

When PCB congener data were used, the total PCB concentration was adjusted by subtracting the concentrations of coplanar PCBs from the total PCB concentration. This was done for purposes of estimating cancer risks because the coplanar PCBs were evaluated separately for the cancer endpoint.

6.2.5.7 Bioavailability of Chemicals

The toxicity values used in the risk assessment are often based on laboratory studies in which the chemical is administered in a controlled setting via food or water. Absorption from environmental media may be lower than that observed in the laboratory. Studies have shown that conditions in environmental media (e.g., pH, organic carbon content) can affect the bioavailability of a chemical (Ruby et al. 1999, Pu et al. 2003, Saghir et al. 2007). If the bioavailability of a chemical in a given environmental medium is less than that in the laboratory study used to derive the toxicity value, the risk assessment will overestimate the exposure to that chemical in that medium. The National Research Council has recommended that consideration of bioavailability be incorporated in decision-making at sites (National Academy of Sciences 2003). While site-specific information on the bioavailability of chemicals in sediment is not available, it is important to recognize that there is uncertainty associated with not incorporating bioavailability into the risk estimates, especially related to sediment-associated chemicals.

6.2.5.8 Exposure Areas for Consumption of Smallmouth Bass

Exposure via consumption of smallmouth bass was evaluated on a river mile basis. Uncertainties associated with the home range of smallmouth bass are discussed in Section 6.1.13. In Round 1, samples were composited on a per river mile basis, Round 3, samples were composited on a per river mile basis for each side of river. The Round 1 and Round 3 results were combined, and the EPC thus represents an exposure area of one river mile. A study by ODFW (ODFW 2005) that included tracking the movement of smallmouth bass in the Lower Willamette indicated that their home range is typically between 0.1 and 1.2 km, and they are most frequently found in near-shore areas.

Figure 6-1 displays the ratios of concentrations of DDT, DDE, DDD, cPAH, dioxin/furan TEQ, and PCB congeners detected in composite smallmouth bass samples collected at the east side of the river mile compared to concentrations for those detected in composite samples collected at the west side of the river mile. At RM 8, 9, and 10, the ratios are all less than 1, indicating concentrations on the east side of the river are generally less than concentrations on the west side of the river. For the remaining river miles, some ratios exceed one. East to west side concentration ratios for PCBs at river mile 11 are highest of any river mile evaluated. As previously discussed in Section 6.1.14, that a fish from RM 11W was included in the composite for RM 11E due to a mislabeling of the sample. Due to the low number of samples for each exposure area, the maximum detected concentration from either side of the river was typically used as the RME EPC for the river mile exposure areas. In addition, the area over which fishing occurs should also be considered. Given an exposure duration of 30 to 70 years, it is possible that fish would be collected over an area greater than a single river mile. Therefore, use of an exposure area consisting of a single river mile for evaluating consumption of smallmouth bass is generally health protective and unlikely to underestimate risks.

6.2.5.9 EPCs in Surface Water for Recreational Beach Users

Only data collected from the low water sampling event was used to assess recreational exposures to surface water, in order to represent surface water conditions during the time of year when most frequent recreational use occurs. There is some uncertainty in the representativeness of this dataset for surface water conditions for recreational users.

Because exposure to surface water by transients can occur throughout the year, data from sampling events during three seasons of the year were used for this scenario and can be used to assess the representativeness of the single low water sampling event. Arsenic was the only surface water COPC detected in recreational exposure areas. The Study Area-wide average total arsenic concentration for transient exposure to surface water, using year-round data, is 0.48 µg/l. The Study Area-wide average total arsenic concentration for recreational beach user exposure to surface water, using low flow data, is 0.51 µg/l. Given the similarity of these results, the uncertainty associated with the recreational beach user surface water dataset should not affect the conclusions of this BHHRA.

6.3 TOXICITY ASSESSMENT

The results of animal studies are often used to predict the potential human health effects of a chemical. Extrapolation of toxicological data from animal studies to humans is one of the largest sources of uncertainty in evaluating toxicity. Much of the toxicity information used in this BHHRA comes from EPA's Integrated Risk Information System (IRIS), which states the following on its website:

> In general IRIS values cannot be validly used to accurately predict the incidence of human disease or the type of effects that chemical exposures have on humans. This is due to the numerous uncertainties involved in risk assessment, including those associated with extrapolations from animal data to humans and from high experimental doses to lower environmental exposures. The organs affected and the type of adverse effect resulting from chemical exposure may differ between study animals and humans. In addition, many factors besides exposure to a chemical influence the occurrence and extent of human disease (EPA 2010b, http://www.epa.gov/iris/limits.htm).

EPA typically applies uncertainty factors, typically a factor 10, when deriving reference doses, to account for limitations in the data. These limitations include variation in susceptibility among the members of the human population, uncertainty in extrapolating animal data to humans, uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure, uncertainty in extrapolating from a LOAEL rather than from a NOAEL, and uncertainty associated with extrapolation when the database is incomplete. As a result, actual risks within the Study Area are likely to be lower than the estimates calculated in this BHHRA.

In addition, the following specific uncertainties have been identified.

6.3.1 Early Life Exposure to Carcinogens

As discussed in Section 3.5.6, early-in-life susceptibility to carcinogens has long been recognized as a public health concern. EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA 2005b) provides a process to evaluate risks from early-life exposure to carcinogens known to act via a mutagenic mode of action. The only exposure scenarios for which early-life exposures are considered are recreational beach use, fish consumption, and household use of surface water. Of the COPCs identified in the risk assessment, only cPAHs have been identified as mutagenic. The BHHRA did not specifically address early-life exposures in the separate child and adult scenarios. However, increased early-life susceptibility was used to assess risks associated with exposure to PAHs in the combined adult/child scenarios. Therefore, the combined adult/child scenario accounts for the additional potency associated with early life exposures.

6.3.2 Lack of Toxicity Values for Delta-hexachlorocyclohexane, Thallium, and Titanium

Delta-HCH was detected in tissue and in-water sediment. An SF or RfD toxicity value could not be identified for delta-HCH according to the hierarchy of sources of toxicity values recommended for use at Superfund sites (EPA 2003b). Also, an STSC review concluded that the other hexachlorocyclohexane isomers could not be used as surrogates for delta-HCH due to differences in toxicity (EPA 2002d). Potential risk from delta-HCH was not quantitatively evaluated because of the lack of availability of toxicity data.

Thallium was detected in in-water sediment and surface water, and titanium was detected in in-water sediment. Thallium and titanium are naturally occurring elements, and although thallium may have a wide spectrum of effects on humans and animals (EPA 2009a), titanium has been characterized as having extremely low toxicity (Friberg et al 1986). An SF or RfD toxicity value could not be identified for titanium according to the hierarchy of sources of toxicity values recommended for use at Superfund sites (EPA 2003b), and consultation with EPA indicated no surrogate toxicity value was available. Therefore potential risk from exposure to titanium was not quantitatively evaluated in this BHHRA.

6.3.3 Use of Toxicity Values From Surrogate Chemicals for Some Chemicals that Lack Toxicity Values

For some chemicals, if a RfD or SF toxicity value was not available from the recommended hierarchy, a structurally similar chemical was identified as a surrogate. The RfD or SF for the surrogate was selected as the toxicity value and the surrogate chemical was indicated in Section 4. Uncertainty exists in using surrogate chemicals to represent the toxicity of chemicals for which toxicity values are not available. Using surrogate toxicity values could over- or under-estimate risk for a specific chemical.

Based on the results of the BHHRA, the chemicals that exceeded the minimum target cancer risks of 1×10^{-6} or hazard quotient of 1 did not rely on surrogate toxicity values. Therefore, the use of surrogate toxicity values should not affect the conclusions of this BHHRA.

6.3.4 Toxicity Values for Chromium

Chromium was analyzed as total chromium in all media. Although toxicity values exist for both trivalent and hexavalent chromium, hexavalent chromium exhibits greater toxicity that the trivalent form. The reference dose for hexavalent chromium is 0.003 mg/kg-day, versus 1.5 mg/kg-day for trivalent chromium. Hexavalent chromium can be reduced to trivalent chromium in an aqueous environmental medium if an appropriate reducing agent is available, and thus trivalent chromium is more prevalent in the environment (ATSDR 2008). Screening values for trivalent chromium were used in the selection of total chromium as a COPC for in-water sediment, beach sediment, the groundwater seep, and surface water. This is an uncertainty because the trivalent chromium screening level is for insoluble salts.

The highest HQ for chromium from fish consumption was 0.004. Even if a portion of the chromium were present as hexavalent chromium, the HQ would likely still be less than 1. Additionally, EPA currently considers the carcinogenic potential of hexavalent chromium via oral exposure as "cannot be determined." Toxicity criteria derived by the New Jersey Dept. of Environmental Protection was used as a Tier 3 source for evaluating the cancer risks associated with oral exposures to hexavalent chromium.

6.3.5 Toxicity Values for Polychlorinated Biphenyls and Applicability to Environmental Data

The toxicity values for PCBs were applied to both PCB congeners (not including coplanar congeners) and Aroclors. The RfD for PCBs is based on an immunotoxicity endpoint for Aroclor 1254 (EPA 2010b). Several other Aroclors have been detected in media within the Study Area, indicating the mixture of PCBs differs from that used in the study to develop the RfD. The cancer SF for PCBs was derived for PCB mixtures based on administered doses of Aroclors to rats. The PCB mixtures used in the studies included the coplanar PCB congeners (dioxin-like PCBs), and coplanar PCBs may have contributed to the carcinogenicity observed in the study. Because the cancer risk from coplanar PCB congeners was evaluated separately, including both the total PCB and coplanar PCB congener risks in the cumulative cancer risk may result in an overestimate of the cancer risks. Although the potential double counting of PCB mass was corrected for by using the PCB adjusted values, there was no correction for the potential double counting of toxicity of dioxin-like PCBs in the PCB TEQ cancer risk estimate.

PCBs are classified as probable human carcinogens based on adequate dose-response data from studies in rats. However, the human carcinogenicity data are inadequate. Several cohort studies have been conducted that analyzed cancer mortality in workers exposed to PCBs. These studies did not find a conclusive association between PCB exposure and cancer; however they were limited by small sample sizes, brief follow-up periods, and confounding exposures to other potential carcinogens. Therefore, using a cancer SF based on the dose-response observed in rats adds further uncertainties to the cancer risk estimates from PCBs as a dose-response has not been observed in humans.

In addition to the uncertainties with toxicity values for total PCBs, there are uncertainties with the toxicity values for the PCB TEQ, which is evaluated using toxicity values for dioxin and dioxin-like compounds. In its 2001 evaluation of the dioxin reassessment, members of the EPA's Science Advisory Board (SAB) did not reach consensus on the classification of 2,3,7,8-TCDD as a carcinogen (EPA 2001d). The National Academy of Sciences (NAS 2006) discussed the primary uncertainties with the toxicity values for dioxin and dioxin-like compounds as follows:

- The estimation of risks at doses below the range of existing reliable data may result in an overestimate of risk. An estimate of risk for typical human exposures to dioxin and dioxin like compounds would be lower in a sub-linear extrapolation model than in the linear model that was used to derive the 2,3,7,8-TCDD SF.

- The issue of appropriately assessing the toxicity of various mixtures of these compounds in the environment. The relative concentrations may change over an exposure period, even though the potency of the individual congeners remains constant. The estimated risk in a given sample depends on both potency and concentration.

The above uncertainties apply to risks from dioxins and furans, as well as risks from dioxin-like PCBs.

6.3.6 Adjustment of Oral Toxicity Values for Dermal Absorption

As discussed in Section 4.7, an adjustment was applied to the oral toxicity factor to account for the estimated absorbed dose when evaluating dermal exposures when the following conditions were met:

- The toxicity value derived from the critical study is based on an administered dose (e.g., through diet or by gavage)

- A scientifically defensible database demonstrates the GI absorption of the chemical is less than 50 percent in a medium similar to the one used in the critical study.

EPA (2004) recommends the adjustment of oral toxicity values to reflect dermal absorption only when GI absorption was less than 50 percent, eliminating the need for small adjustments in the oral toxicity value that are not supported by the level of accuracy in the critical studies that are the source of the toxicity values. Organic chemicals are generally well absorbed across the GI tract, absorption of inorganic chemicals is dependent on a number of factors, but is generally less than for organic chemicals. However, in the absence of a specific value for GI absorption, a default of 100 percent was used. EPA 2004 states that assuming 100 percent absorption may underestimate dermal risk for those chemicals that are poorly absorbed because it overestimates the dose at the site of action. The extent of underestimation is proportional to the actual GI absorption. Inorganic COPCs for which the default value of 100 percent GI absorption was used are aluminum, arsenic, boron, cobalt, copper, iron, molybdenum, selenium, thallium, and zinc.

6.4 RISK CHARACTERIZATION

Uncertainties arise during risk characterization due to the methods used in calculating, summing, and presenting risks. The following subsections address uncertainties associated with the risk characterization of this BHHRA.

6.4.1 Endpoint-specific Hazard Indices

In deriving endpoint-specific HIs, only one health endpoint is used for each chemical, even though some chemicals may have a myriad of health effects as exposures increase. As an example, a majority of the non-cancer affect from the site is from PCBs and total TEQ. The endpoint used for deriving the RfD for PCBs is immunotoxicity, while the endpoint used for deriving the RfD for dioxin/furan TEQ and PCB TEQs is reproductive effects. If the reproductive endpoint for PCBs based upon the lowest observed adverse effects level (LOAEL) of 0.02 mg/kg/day is used with the same Uncertainty Factor as the immunological endpoint to derive an RfD for a reproduction endpoint for PCBs, the RfD for reproductive effects would be a factor of 4 greater than the RfD for immunological effects. Using this ratio, the endpoint-specific HI for reproduction for this exposure scenario for PCBs would be 5,000/4 = 1,250. The total HI for reproduction effects, combining HIs for total TEQ (500) and non-dioxin-like PCBs (1,250), would increase from 500 to 1,750. For the chemicals that have the largest non-cancer contribution in the HHRA, there is a possibility of under-predicting non-cancer health effects by using only one endpoint per chemical.

6.4.2 Risks from Cumulative or Overlapping Scenarios

Where multiple exposure scenarios exist for a given population, the risks for each of the exposure scenarios that are considered potentially complete and significant for a given population were summed to estimate the cumulative risks for that population (see Tables 5-199 and 5-200). In calculating the cumulative risks, the maximum cancer risk for each RME scenario was used. This provides a conservative approach, as the same individual may not experience the maximum exposure under more than one exposure scenario. However, due to the fact that risks from one scenario are usually orders of magnitude higher than any other scenario for a given receptor, risks from potential cumulative scenarios should not affect the conclusions of this BHHRA. However, the possible magnitude of uncertainty associated with risks from cumulative or overlapping scenarios is discussed further in Attachment F6.

In addition to cumulative exposure scenarios for a given population, an individual may be a member of multiple exposure populations, and thus overlapping exposure scenarios. Because there are numerous possible combinations of overlapping scenarios due to variations in exposure points and exposure assumptions, a model was not developed to quantitatively evaluate overlapping scenarios in this BHHRA. However, because the risk from fish and shellfish consumption is typically at least 10-fold greater than other exposure pathways, if an individual consumes fish, the relative contribution from other exposure scenarios is not likely to contribute significantly to the overall risks for that individual. This BHHRA presents the risks for all of the exposure scenarios, so the risks for a given overlapping scenario could be calculated simply by summing the risks for each of the exposure scenarios that make up the overlapping scenario.

This BHHRA assessed potential risks from exposure to media within the Study Area. Upland sites were not included in this BHHRA. If exposure to upland sites were incorporated with exposures to media within the study, the overall estimate of cumulative risk would likely be higher than the risk estimates in this BHHRA.

6.4.3 Risks from Background

Metals are naturally occurring and the concentrations present in tissue, water, or sediment may not be directly related to contamination. Reported concentrations of arsenic and mercury in samples collected within the Study Area result in estimated risks greater than 1×10^{-6} or an HQ of 1 for one or more of the exposure scenarios evaluated in the BHHRA. Exposure concentrations of arsenic in beach sediment ranged from 0.7 mg/kg to 9.9 mg/kg, within the general range of 7 mg/kg used as a background concentration of arsenic by DEQ (DEQ 2007). At the background concentration of 7 mg/kg, the calculated risk from arsenic would exceed 1×10^{-6} for several of the beach sediment and in-water sediment exposure scenarios evaluated in this BHHRA.

Neither background nor anthropogenic tissue concentrations of COPCs were established for the Study Area. Regional tissue concentrations were measured as part of the Columbia River Basin Fish Contaminant Survey in five anadromous species (Pacific lamprey, smelt, coho salmon, fall and spring Chinook salmon, steelhead) and six resident species (largescale sucker, bridgelip sucker, mountain whitefish, rainbow trout, white sturgeon, walleye). All samples were composites; the size of the individual fish varied with species. Concentrations of certain contaminants are higher in tissue collected within the Study Area than observed in the Columbia River study, and the sources of the regional tissue concentrations are unknown. Consistent with EPA policy, risk estimates were presented in this BHHRA without accounting for contributions from background. However, it is important to recognize that background concentrations may result in unacceptable risk and hazard estimates.

6.4.4 Risks from Lead Exposure

The maximum EPC calculated for lead are associated with a probability of exceeding protective blood lead levels in the fetus of a pregnant woman who consumes fish from the Study Area. This EPC may be attributable to lead in the gut of the fish rather than tissue concentrations. Protective lead concentrations in tissue were estimated using the EPA Adult Lead Methodology (ALM) (EPA 2003c), based on agreements with the EPA to follow the same methodology used in the CRITFC (1994) survey to assess tissue exposures from lead. The ALM as adapted for the Portland Harbor BHHRA focuses on potential affects to the fetus when considering fish consumption by pregnant women. However, the ALM was developed for evaluating exposure to lead in soil and may not be appropriate to use for fish consumption. Furthermore, the ALM is sensitive to the bioavailability of ingested lead. For purposes of calculating a tissue concentration of lead that is expected to be without adverse effects, the default bioavailability of lead in soil was used, and it is not known whether this is an appropriate assumption for lead in tissue.

6.4.5 Future Risks

This BHHRA estimated current and future risks for exposure within the Study Area, based on known and reasonably anticipated future uses of the Study Area. However, the LWR is a dynamic, industrialized waterway, and if the land uses in certain areas of the Study Area were to change in the future in a manner with the uses considered in the BHHRA, risk and hazard estimates presented here may not be representative of conditions in the future.

6.5 OVERALL ASSESSMENT OF UNCERTAINTY

A summary of the uncertainties and a qualitative classification of their magnitude, their impact on the health protectiveness of the assessment, and their significance to risk management decisions are presented in Table 6-1. For each of the uncertainties identified and discussed in this section, Table 6-1 provides a qualitative assessment (using High, Medium, and Low as descriptors) for each of these properties. In addition, the table presents whether an uncertainty is more likely to over-estimate or under-estimate actual risks from the Study Area. While there are numerous uncertainties identified for this BHHRA, and the cumulative effect of these uncertainties could be significant to the conclusions of the BHHRA, some of these uncertainties would be expected to have more of a significant effect on risk management decisions than other uncertainties. These are identified with a "High" descriptor under the "Significance to Risk Management" column in Table 6-1.

Risk assessments typically include conservative assumptions to minimize the chances of underestimating exposure and/or risks of adverse effects to human health, and therefore potentially underestimating the need for remedial actions. In this BHHRA, conservative assumptions were incorporated into the identification of exposure scenarios, the selection of exposure assumptions, the development of EPCs, and the use of toxicity values. Only a portion of the uncertainties in this BHHRA are quantifiable. Further analysis of the data and review of pertinent published literature provided a possible range of values for some of the uncertainties presented above. The magnitude of these ranges are provided in Attachment F6 and discussed in this Section.

While it is not probable that the maximum values of the uncertainties apply for every tissue consumption exposure scenario and contaminant , this magnitude of uncertainty indicates that risks may actually be less than 1 x 10^{-4} or HI of 1 for certain scenarios.

While conservative, the results of the BHHRA are intended to show the relative risks associated with the exposure scenarios, and which contaminants are contributing the highest percentage of the calculated risks.

7.0 SUMMARY

The overall objective of this BHHRA is intended to provide an analysis of baseline risks and help determine the need for action at the Site, and to provide risk managers with an understanding of the actual and potential risks to human health posed by the site and any uncertainties associated with the assessment.

The populations evaluated in the BHHRA were identified based on human activities currently known to occur within the Study Area or could occur in the future, as described in the Programmatic Work Plan or in subsequent direction from EPA. Populations and associated exposure scenarios that were quantitatively evaluated in this BHHRA include:

- Dockside Workers – Direct exposure to beach sediment
- In-water Workers – Direct exposure to in-water sediment
- Recreational Beach Users – Direct exposure to beach sediment and surface water
- Transients – Direct exposure to beach sediment, surface water, and groundwater seep
- Divers – Direct exposure to in-water sediment and surface water
- Recreational and Subsistence Fishers – Direct exposure to beach or in-water sediment, consumption fish and shellfish
- Tribal Fishers – Direct exposure to beach and in-water sediment, consumption of fish
- Domestic Water Use – Direct exposure to surface water used as a domestic water source
- Infants - Indirect exposure to bioaccumulative contaminants (PCBs, dioxin/furans, DDx, and PDBEs) in environmental media via indirect exposures due to breastfeeding.

7.1 SUMMARY OF RISKS

A comparison of the estimated risks by exposure media can help focus risk management decisions by identifying the media contributing most to the overall human health risks at the Study Area. As discussed in Sections 5, the magnitude of risk varies greatly across the different scenarios. Figures 7-1 and 7-2 display the ranges of total cumulative cancer risk and endpoint-specific HIs, respectively, for each media type, based on CT exposure assumptions for each media evaluated in the BHHRA. Figures 7-3 and 7-4 display the ranges of total cumulative cancer risk and cumulative HIs, respectively, based on RME assumptions. The estimated risks associated with consumption of fish and shellfish are orders of magnitude higher than risks from other scenarios, and exceed a cumulative cancer risk of 1 x 10^{-4} and a HI of 1. Scenarios for which the cumulative estimated cancer risk is greater than 1 x 10^{-4} or the HI is greater than 1 are consumption of fish and shellfish scenarios and direct contact with in-water sediment by tribal and high frequency fishers.

7.2 CONTAMINANTS POTENTIALLY POSING UNACCEPTABLE RISKS

One role of the BHHRA is to identify those contaminants that pose the greatest risks to current and future receptors, along with the media and exposures routes associated with those risks. This information is used to inform response actions. This section presents the primary contributors to human health risk at the Site. The exposure scenarios and chemicals discussed here represent a subset of the scenarios and contaminants evaluated in this BHHRA.

Contaminants were identified as potentially posing unacceptable risks if the estimated cancer risk is greater than 1 x 10^{-6} or the HQ is greater than 1 for any of the exposure scenarios evaluated in this BHHRA, regardless of the uncertainties associated with the estimates. Given the uncertainties in the analytical data discussed in Section 6, the preliminary list was further refined to select the final listing of contaminants potentially posing unacceptable risks for this BHHRA. This can assist with the development of the FS by focusing on those scenarios and contaminants associated with the greatest overall risk in the Study Area. While these scenarios and contaminants may be the focus of the remedial analyses, other exposure scenarios and contaminants potentially posing unacceptable risks may still be considered in remedial decisions for the Site.

α-, β-, and γ-Hexachlorocyclohexane and heptachlor were detected in fish tissue only as N-qualified data. Due to retention time issues in the analytical methods used for the Round 1 tissue samples, some of the pesticide tissue data were N-qualified, indicating that the identity of the chemical could not be confirmed. In the subsequent Rounds 2 and 3 sampling events, different analytical methods were used so that the identification of pesticides was not an issue in tissue. EPA guidance (1989) recommends caution in the use of data where there are uncertainties in the identification of contaminants. Therefore, if a chemical was identified as potentially posing unacceptable risks based only on the use of N-qualified data, that chemical is not recommended for further evaluation for potential risks to human health.

Additional considerations in the selection of contaminants potentially posing unacceptable risk included:

- The relative percentage of each contaminant's contribution to the total human health risk consistent with assumptions on exposure areas.
- Uncertainties associated with the exposure scenarios, such as the likelihood of future site use, number of assumptions made in estimating exposure, or level of uncertainty in estimates of exposure variables.
- Frequency of detection, both on a localized basis and Study Area-wide.
- Comparison of risks within the Study Area to risks based on measured regional contaminant concentrations for similar exposure scenarios, indicating background or other anthropogenic sources of chemicals in the region.
- Magnitude of risk greater than EPA's target range for managing cancer risk of 1 x 10^{-4} to 1 x 10^{-6} and noncancer hazard of 1.

The contaminants potentially posing unacceptable risks based on the above criteria are discussed below, and those recommended for further evaluation for potential risks to human health are presented in Table 7-1.

7.2.1 Fish Consumption Scenarios

Twenty six COCs (PCBs, dioxins, six metals, Bis-2-ethylhexyl phthalate (BEHP), PAHs, hexachlorobenzene, and seven pesticides) are identified as potentially posing unacceptable risks associated with fish consumption:

- PCBs (PCBs and PCB TEQs): Based on the magnitude of the estimated risks greater than 1 x 10^{-4}, the overall spatial scale, and the relative contribution to cumulative risk estimates.

- Dioxins/furans: Based on localized and Study Area-wide exposures, the magnitude of the risk estimates greater than 1 x 10^{-4}, the overall spatial scale, and the relative contribution to cumulative risk estimates.

- Metals: Antimony, arsenic, mercury, selenium, and zinc were associated with one or more fish consumption exposure scenarios that resulted in a risk estimate that exceeded a cancer risk of 1 x 10^{-6} or HQ of 1.
    - The overall estimated risk estimates for arsenic are greater than 1 x 10^{-4} based on Study Area-wide exposures.
    - The HQ associated with antimony is greater than 1 at RM 10 based on consumption of whole body smallmouth bass tissue.
    - Lead, based on a measured tissue concentration greater than the protective tissue concentrations derived using blood lead models. However, this is due to only a single result of smallmouth bass whole body tissue collected at RM 10 with anomalously high result, as discussed in Section 6.1.14
    - Mercury, based on an HQ of 1 for both localized and Study Area-wide exposures.

  - Selenium, based on an HQ of 1 at RM 11 for consumption of smallmouth bass fillet tissue, in a single sample.
  - Zinc, based on an HQ of 2 in a single sample of whole body common carp collected from RM 4 to RM 8.

- BEHP, based on cancer risk estimates greater than 1 x 10^{-6} on both a localized and Study Area-wide basis, and RME cancer risk estimates greater than 1 x 10^{-4} and a HQ greater than 1 at RM 4 based on consumption of smallmouth bass for recreational and subsistence fishers.

- PAHs: Benzo(a)anthracene, benzo(a)pyrene, dibenzo(a)anthracene, and total cPAHs, based on cancer risk estimates greater than 1 x 10^{-6}. Cancer risk estimates for total carcinogenic PAH are greater than 1 x 10^{-6} at five river mile segments and Study Area-wide based on consumption of smallmouth bass and for two fishing zones and Study Area-wide based on consumption of common carp.

- Organochlorine Pesticides: Aldrin, dieldrin, heptachlor epoxide, total chlordane, total DDD, total DDE, and total DDT are identified based on estimated cancer risks greater than 1 x 10^{-6} or an HQ of 1.
  - Aldrin, based on cancer risk estimates greater than 1 x 10^{-6} for subsistence fishers for single-species diet of common carp at localized areas and Study Area-wide.
  - Dieldrin, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - Heptachlor epoxide, based on estimated cancer risk estimates greater than 1 x 10^{-6} for single-species diet of common carp by subsistence fishers at RM 0 to RM 4.
  - Total chlordane, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - DDD, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis.
  - DDE, based on estimated cancer risks greater than 1 x 10^{-6} for consumption of all fish species on a localized and Study Area-wide basis, and an HQ greater than 1 at RM 7, based on consumption of smallmouth bass.
  - DDT, based on an estimated cancer risk greater than 1 x 10^{-6} based on consumption of all fish species on a localized and Study Area-wide basis.
  - PDBEs, based on an HQ greater than 1 for consumption of smallmouth bass and carp on a localized basis.

Considering the magnitude and relative contribution to the overall risk estimates, as well as their frequency of detection, PCBs and dioxins/furans are the most significant contributors to risk for fish consumption scenarios. Estimated risks from PCBs and dioxins/furans are greater than 1 x 10^{-4} or an HQ of 1 for both the CT and RME evaluations at both localized and Study Area-wide exposures. Figure 7-5 illustrates the relative contribution of individual contaminants to cumulative risk estimates based on the Study Area-wide multi-species fish consumption by adult subsistence fishers. PCBs are the primary contributor to the overall risk estimate, and taken together with dioxins/furans expressed as a TEQ account for the majority of the estimated risk. Figure 7-6 shows the relative contributions to the overall risk estimate based on Tribal fish consumption.

PCBs and dioxins/furans have been detected in fish tissue collected outside of the Study Area in both the Willamette and Columbia Rivers. In a risk assessment for the mid-Willamette (EVS 2000), PCB concentrations were found to result in a HQ greater than 1 assuming both a 142 g/day and a 17.5 g/day consumption rate, and an estimated cancer risk greater than 1 x 10^{-4} for the 142 g/day consumption rate. Dioxins and furans were also found to result in an estimated cancer risk greater than 1 x 10^{-4} using a 142 g/day consumption rate (non-cancer endpoints were not evaluated for dioxins and furans). In the Columbia River Basin Fish Contaminant Survey (EPA 2002c), the estimated cancer risks associated with PCBs and dioxins/furans were greater than 1 x 10^{-4} assuming a consumption rate of 142 g/day, and the estimated risk due to PCBs was greater than 1 x 10^{-4} assuming a consumption rate of 7.5 g/day. While ambient concentrations have not been established for fish tissue, as discussed in Section 6.4.2, regional tissue concentrations may be associated with unacceptable risks from fish consumption, especially at higher consumption rates. While the concentrations in the Study Area are higher than the regional tissue concentrations, the sources of PCBs and dioxins and furans in regional tissue data are unknown, and efforts are underway to reduce regional tissue concentrations.

7.2.2 Shellfish Consumption Scenarios

Seventeen contaminants (PCBs, dioxins, arsenic, PAHs, pentachlorophenol, and five pesticides) were identified as potentially posing unacceptable risks due to consumption of shellfish, based on estimated cancer risks greater than 1 x 10^{-6} or a HQ of 1:

- PCBs (Total PCBs and PCB TEQs): Based on cancer risk estimates greater than 1 x 10^{-4} and/or HQs greater than 1 for shellfish consumption in localized and Study Area-wide exposures, the magnitude and spatial scale of the risk estimates greater than 1 x 10^{-4}, their relative contribution to cumulative risk estimates, and their frequency of detection.

- Dioxins/furans (Total dioxin/furan TEQs): Based on cancer risk estimates greater than 1 x 10^{-4} and/or HQs greater than 1 for shellfish consumption in localized and Study Area-wide exposures, the magnitude and spatial scale of the risk estimates greater than 1 x 10^{-4}, their relative contribution to cumulative risk estimates, and their frequency of detection.

- Arsenic: Based on cancer risk estimates that greater than 1 x 10^{-6} from clams and crayfish at both consumption rates and on a localized and Study Area-wide scale. No cancer risk estimates exceeded 1 x 10^{-4}. Though arsenic is identified as a contaminant potentially posing unacceptable risk on both a localized and Study Area-wide spatial scale, concentrations in shellfish tissue are due in part to the contribution of background concentrations.

- cPAHs: Based on cancer risk estimates greater than 1 x 10^{-6} from both clams and crayfish at both ingestion rates and on a localized and Study Area-wide scale. Cancer risk estimates greater than 1 x 10^{-4} from clams collected at locations RM 5W and RM 6W and assuming a consumption rate of 18 g/day. cPAHs are considered a primary contributor to risk for the shellfish consumption pathway at those locations because of the magnitude of the risk estimates and their relative contribution to the cumulative risk.

- Pentachlorophenol: Pentachlorophenol was detected only in a single crayfish composite sample collected near RM 8. It was not detected in the remaining 40 shellfish samples. This single detection of pentachlorophenol resulted in a cancer risk estimate within the range of 1 x 10^{-6} to 1 x 10^{-4}.

- Organochlorine pesticides (Aldrin, dieldrin, total DDD, total DDE, and total DDT): aBsed on an estimated cancer risk greater than 1 x 10^{-6} or a HQ of 1.
    - Aldrin, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams at RM 8W and on a Study Area-wide basis, assuming a consumption rate of 18 g/day.
    - Dieldrin, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.
    - Total DDD, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.
    - Total DDE, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 6W, RM 7W, RM 8W and Study Area-wide, assuming a consumption rate of 18 g/day.
    - Total DDT, based on an estimated cancer risk greater than 1 x 10^{-6} for consumption of clams near RM 6W and RM 7W, assuming a consumption rate of 18 g/day.

Considering the magnitude and relative contribution to the total risk estimates and their frequency of detection, PCBs, dioxins/furans, and cPAHs are the most significant contributors to the risk estimates associated with consumption of shellfish. PCBs and dioxins/furans contribute approximately 58 percent and 91 percent, respectively, of the cumulative cancer risk from consumption of clams and crayfish, cPAHs contribute approximately 35 percent and 5 percent, respectively, of the cumulative cancer risk from consumption of clams (undepurated samples) and crayfish. PCBs and dioxins/furans contribute are the most significant contributors to the risk estimates on a Study Area-wide basis, while cPAHs are contribute significantly to the risk estimates on a localized basis at RM 5W and RM 6W.

7.2.3 In-Water Sediment Scenarios

PAHs (primarily benzo[a]pyrene), arsenic, PCBs, and dioxins are identified as contaminants potentially posing unacceptable risk for in-water sediment. PAHs and dioxins are identified for all of the in-water sediment scenarios, arsenic and PCBs were identified for the tribal fisher and high frequency fisher scenarios only. The relative contribution of each contaminant to cumulative cancer risk estimates varied by river mile. On a Study Area-wide basis, estimated risks from cPAHs and dioxins/furans each contributed approximately 50 percent of the cumulative cancer risk estimate. As previously discussed, cumulative cancer risks associated with arsenic are due in part to naturally occurring concentrations in sediment. Cumulative cancer risks from PCBs are greater than 1 x 10^{-6} at four one-half mile river segments, and from dioxins at two one-half mile segments. Cumulative cancer risks from cPAHs are greater than 1 x 10^{-6} for at 22 one-half mile river segments. Carcinogenic PAHs contribute significantly to risks associated with in-water sediment exposures on a Study Area-wide basis based on the relative magnitude and spatial scale of estimated risks greater than 1 x10^{-4}. PCBs and dioxins contribute significantly to the risk estimates on a localized basis at RM 8.5W (PCBs) and RM 7W (dioxins/furans).

7.2.4 Beach Sediment Scenarios

PAHs (primarily benzo[a]pyrene) and arsenic were identified as potentially posing unacceptable risk in beach sediment. Risks greater than 1 x 10^{-6} associated with exposure to arsenic in beach sediment are due in part to naturally occurring concentrations of arsenic. Risks greater than 1 x 10^{-6} associated with exposure to benzo(a)pyrene was limited to a few locations, with the maximum cumulative cancer risk at beach location 06B025.

7.2.5 Surface Water Scenarios

PAHs are the primary contributor to risks associated with direct contact to surface water. Estimated cancer risks are greater than 1 x 10^{-4} assuming use of river water as a domestic water source, and greater than 1 x 10^{-6} for divers at RM 6W. However, as noted in Section 5.2.8, the estimated risks associated with dermal exposure to PAHs in water should be used with caution, as PAHs are not within the Effective Prediction Domain of the model used to estimate the dermally-absorbed dose. Additional risk management considerations during remedy selection should consider the limited spatial scale and degree of uncertainty associated with the diver exposure assumptions. HIs greater than 1 at Multnomah Channel and RM 8.5 were associated with use of river water as a drinking water source.

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Cc: []
From: CN=Elizabeth Allen/OU=R10/O=USEPA/C=US
Sent: Fri 9/14/2012 5:28:08 PM
Subject: Fw: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment
jworonets@anchorqea.com
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(embedded image)

Responses in bold below.
----- Forwarded by Elizabeth Allen/R10/USEPA/US on 09/14/2012 10:09 AM -----

From: "Wyatt, Robert" <rjw@nwnatural.com>
To: Deb Yamamoto/R10/USEPA/US@EPA,
Cc: Cami Grandinetti/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, David Ashton <david.ashton@portofportland.com>, Dave Livesay <dlivesay@gsiws.com>, Elizabeth Allen/R10/USEPA/US@EPA, "Fred Wolf email 2 **Personal Privacy / Ex. 6** **Personal Privacy / Ex. 6** Fred G. Wolf (Frederick.wolf@total.com)" <Frederick.wolf@total.com>, "Jessica Hamilton (Jessica.Hamilton@portofportland.com)" <Jessica.Hamilton@portofportland.com>, James McKenna <jim.mckenna@verdantllc.com>, Jennifer Woronets <jworonets@anchorqea.com>, "Karen Moynahan (karen.moynahan@portlandoregon.gov)" <karen.moynahan@portlandoregon.gov>, "Karen Traeger (karen.traeger@total.com)" <karen.traeger@total.com>, "Madalinski, Kelly" <Kelly.Madalinski@portofportland.com>, "Kim Cox (kim.cox@portlandoregon.gov)" <kim.cox@portlandoregon.gov>, Kristine Koch/R10/USEPA/US@EPA, "'LauraKennedy@KennedyJenks.com'" <LauraKennedy@KennedyJenks.com>, Lori Cora/R10/USEPA/US@EPA, Patty Dost <pdost@pearllegalgroup.com>, Sheila Fleming/R10/USEPA/US@EPA, "Steve Parkinson (sparkinson@jzplaw.com)" <sparkinson@jzplaw.com>
Date: 09/14/2012 09:46 AM
Subject: RE: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

Deb,

Thank you for the quick response. The LWG wants to reiterate that that we are encouraged by the progress that has been made on the Reasonable Maximum Exposure (RME) issue. We are optimistic that we can develop an RME approach that will be acceptable to both the LWG and EPA.

We have an acceptable RME approach. It represents only a slight modification to what was envisioned as far back as 2003, such that we have given ground on the mile-by-mile assessment for subsistence fishers, and the use of both whole body consumption and single species diets for recreational fishers.

To be clear, the LWG is not proposing an alternative approach. The request for additional time is to discuss factors used in EPA's proposed approach. During the August 27th meeting the LWG was tasked to develop an RME proposal. The LWG provided the RME proposal to EPA on August 29th and we expected to discuss that proposal with EPA during the meeting on Monday. However on Monday afternoon, instead of discussing the LWG proposal, EPA provided an oral description of an alternative proposal. The LWG requested a written version of that approach, which EPA provided on Tuesday afternoon.

I'd suggested that 4 hrs would be woefully inadequate to discuss all of the issues. Apparently, the LWG was unwilling to commit to sufficient time to fully resolve the issues. That we only began to discuss fish consumption after 3 hrs 40 minutes of listening to them repeat the same arguments they've already provided for nearly a decade speaks the the LWG's apparently lack of perspective regarding which issues are truly important here.

Given that the LWG received EPA's RME proposal on Tuesday afternoon, we haven't had time to fully evaluate the approach; however, two of our specific concerns with EPA's proposal are the use of 73 g/day for a recreational fisher and the use of smallmouth bass as a surrogate for a multi-species diet. We think it would be beneficial to meet with EPA to better understand EPA's rationale for the proposed RME factors and to discuss the options for addressing the LWG's concerns, recognizing that there are multiple assumptions in the exposure calculations for fish consumption. We would also like to discuss the potential impacts on the Feasibility Study associated with EPA's proposal.

The rationale for our assumptions was clearly provided in both the revised risk assessment given to them on June 22, and again on Tuesday. Further discussion regarding specifics as to how to implement the revised approach in the risk assessment are appropriate, it isn't clear to me whether that is part of the informal dispute discussion process. They either agree to find a workable way to implement the revisions, or not. But first they have to accept the concept. "Impacts" to the FS are beyond the scope of the BHHRA, and had the LWG even once communicated with EPA regarding some of the presumptions they intended to base some of their FS evaluations on, this could have been avoided from their perspective. In reality, the FS is largely unaffected, PCB cleanup will be based on anthropogenic background. The LWG's analysis that the PCB PRG was in reality 80 ppb was never going to be acceptable, regardless of any changes to the BHHRA.

In addition, the LWG is currently revising text related to the primary contributor issue and clam consumption language, and we will provide our proposed redlines to EPA this morning.

Apparently, the LWG's concept of time involves some permutation of the time-space continuum that we can't observe from our particular perspective in the universe.

Finally, we believe that EPA's deletion of an executive summary and conclusions from the BHHRA remains unresolved, as do the notice of non-compliance and process issues we have raised as part of our dispute.

We will write an executive summary when the rest of the risk assessment is finalized. It will pay great homage to the part of the title that is "summary."

Thank you for the clarification on the formal dispute process schedule.
Bob

From: Deb Yamamoto [Yamamoto.Deb@epamail.epa.gov]
Sent: Thursday, September 13, 2012 11:48 AM
To: Wyatt, Robert
Cc: Cami Grandinetti; Chip Humphrey; David Ashton; Dave Livesay; Elizabeth Allen; Fred Wolf email 2
Personal Privacy / Ex. 6 Fred G. Wolf (Frederick.wolf@total.com); Jessica Hamilton (Jessica.Hamilton@portofportland.com); James McKenna; Jennifer Woronets; Karen Moynahan (karen.moynahan@portlandoregon.gov); Karen Traeger (karen.traeger@total.com); Madalinski, Kelly; Kim Cox (kim.cox@portlandoregon.gov); Kristine Koch; 'LauraKennedy@KennedyJenks.com'; Lori Cora; Patty Dost; Sheila Fleming; Steve Parkinson (sparkinson@jzplaw.com)
Subject: RE: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

Bob -

We are disappointed that the LWG did not accept EPA's RME proposal. We believe we have accommodated many of the LWG's concerns while identifying what is a reasonable RME for the Portland Harbor Superfund Site. Unfortunately, you did not provide a specific counter proposal for EPA to use in deciding whether extending the informal dispute process would be fruitful. At this stage in the dispute process, concrete proposals are needed to reach agreement and to know whether we are resolving issues. Before we can decide whether to extend the informal dispute process, we need to get a specific counter proposal for the fish consumption RME/CT scenario and a list of any remaining dispute issues, including specific resolution language, by 10:00 am tomorrow, September 14. We also need to know whether the LWG has issues it will raise to formal dispute even if all language changes to the BHHRA are agreed to. We will consider this information in determining whether or not an extension of time is warranted to further discuss these issues.

EPA appreciates the efforts made by the LWG to reach the agreements that have been made to date. I hope you understand why at this point it is important for the LWG to be absolutely clear on its position for any remaining unresolved issues if there is to be any further attempt to resolve these issues informally.

Regarding the formal dispute process schedule. EPA does not agree that the LWG requires two weeks to reply to EPA's Response Brief, one week is sufficient. Thus, if the informal process is not extended, the LWG's Dispute Brief will be due Sept. 21, EPA's Response will be due by October 10, and the LWG's reply due by October 17th. If the LWG wishes to present its argument to the Director in person, that meeting must be scheduled within two weeks of October 17th.

If the informal dispute is extended, we would expect the schedule to remain the same in number of days, except EPA will only need two weeks for its Response as legal counsel will be available for those later two weeks.

Deb Yamamoto, Manager
Site Cleanup Unit 2
Environmental Cleanup Office
U.S. Environmental Protection Agency
M/S ECL-115
1200 Sixth Avenue
Seattle, WA 98101
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"Wyatt, Robert" ---09/12/2012 04:06:58 PM---Hi Kristine, Thank you for your September 11, 2012 email which provided the EPA approach for calcula

From: "Wyatt, Robert" <rjw@nwnatural.com>
To: Kristine Koch/R10/USEPA/US@EPA, Jennifer Woronets <jworonets@anchorqea.com>

Cc: Cami Grandinetti/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, David Ashton <david.ashton@portofportland.com>, Deb Yamamoto/R10/USEPA/US@EPA, Dave Livesay <dlivesay@gsiws.com>, Elizabeth Allen/R10/USEPA/US@EPA, "Fred Wolf email 2 Personal Privacy / Ex. 6 <frederickwolf@wamail.net>, "Fred G. Wolf (Frederick.wolf@total.com)" <Frederick.wolf@total.com>, "Jessica Hamilton (Jessica.Hamilton@portofportland.com)" <Jessica.Hamilton@portofportland.com>, James McKenna <jim.mckenna@verdantllc.com>, "Karen Moynahan (karen.moynahan@portlandoregon.gov)" <karen.moynahan@portlandoregon.gov>, "Karen Traeger (karen.traeger@total.com)" <karen.traeger@total.com>, "Madalinski, Kelly" <Kelly.Madalinski@portofportland.com>, "Kim Cox (kim.cox@portlandoregon.gov)" <kim.cox@portlandoregon.gov>, "'LauraKennedy@KennedyJenks.com'" <LauraKennedy@KennedyJenks.com>, Lori Cora/R10/USEPA/US@EPA, Patty Dost <pdost@pearllegalgroup.com>, "Steve Parkinson (sparkinson@jzplaw.com)" <sparkinson@jzplaw.com>, Sheila Fleming/R10/USEPA/US@EPA
Date: 09/12/2012 04:06 PM
Subject: RE: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

Hi Kristine,

Thank you for your September 11, 2012 email which provided the EPA approach for calculating Reasonable Maximum Exposure (RME) for recreational and subsistence fish consumption in the Baseline Human Health Risk Assessment. Although we are encouraged by the progress we have made on this issue (e.g. EPA's proposal to use a site wide multi-species fillet diet), we are unwilling to accept the RME approach as described. We are interested in continuing our technical discussions on the approach and RME factors to determine whether we can come to agreement. Further discussions would include the fish ingestion rates, exposure area scales (site-wide versus river mile), smallmouth bass versus a multi-species diet, and whole body consumption. If EPA agrees that further discussions would be productive, we believe that a two week extension to the current informal dispute negotiation deadline is appropriate. If EPA does not agree that additional discussion would be productive, then no additional time is needed.

The LWG also agrees to the briefing schedule provided by Lori Cora in her email on September 7, 2012 for the formal dispute process, with the LWG opening brief due one week after the expiration of the informal dispute process on September 21. We would also like to request an additional week for the reply brief to accommodate the LWG internal review process.

If an extension to the informal technical negotiations is approved by EPA, the LWG opening brief would be extended as well to be due one week after completion of informal negotiations. The remaining dates would also need to be adjusted appropriately taking into account vacation schedules.

Also, just as a reminder, we are waiting to receive EPA's RLSO version of the document reflecting the edits made in our meeting on Monday.

Thank you,

Bob

From: Kristine Koch [Koch.Kristine@epamail.epa.gov]
Sent: Tuesday, September 11, 2012 3:34 PM
To: Jennifer Woronets; Wyatt, Robert
Cc: Cami Grandinetti; Chip Humphrey; David Ashton; Deb Yamamoto; Dave Livesay; Elizabeth Allen; Fred Wolf email 2 Personal Privacy / Ex. 6 ; Fred G. Wolf (Frederick.wolf@total.com); Jessica Hamilton (Jessica.Hamilton@portofportland.com); James McKenna; Karen Moynahan (karen.moynahan@portlandoregon.gov); Karen Traeger (karen.traeger@total.com); Madalinski, Kelly; Kim Cox (kim.cox@portlandoregon.gov); 'LauraKennedy@KennedyJenks.com'; Lori Cora; Patty Dost; Steve Parkinson

(sparkinson@jzplaw.com); fleming.sheila@epa.gov
Subject: Re: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

Bob,

Per the agreement from yesterday's discussion, I am providing EPA's view of the reasonable maximum exposure (RME) for recreational and subsistence fish consumption in the baseline human health risk assessment.

Recreational Fishers: Will be assessed on both a harbor-wide and river mile basis. Recreational fishers are assumed to consume a multi-species diet of resident fish, which for our purposes will consist of equal proportions of the four resident species for which we have data. The consumption rates are 17.5 g/day as a central tendency estimate, 73 g/day as a RME. Consumption will be assessed as fillet with skin only, and no reduction in concentrations for cooking methods. Both RME and CT will be assessed as the cumulative child and adult exposure for cancer endpoints, child-only exposure for noncancer endpoints, and for infant exposure via breast milk for persistent bioaccumulative chemicals. Assessment of consumption of a river mile scale is justified because many fishers will repeatedly frequent the same area either from habit, past fishing success, and accessibility. Not all fishers have access to the river using boats, some may rely on public transportation and primarily access areas located closest to bus lines. 73 g/day is approximate ten 8-oz meals per month, a multi-species diet accounts for varying fishing practices, opportunism in catch, although we acknowledge that many individuals exhibit a strong preference for certain species. The LWR is a large water body, and 73 g/day is a sustainable rate on a long-term basis for a substantial portion of the population. Because only smallmouth bass data are available on a river mile basis, that data will be presumed representative of overall tissue concentrations on a river mile scale, and presented as the risk estimates on the risk assessment. Since there are no fillet-only data for Swan Island Lagoon, whole body data will be used, with a comparison of whole-body versus fillet concentrations overtly discussed.

Subsistence fishers will be assessed at a 142 g/day consumption rate, multi-species diet of resident fish, assuming both whole body and fillet with skin consumption. Subsistence fishers consume more than the fillet, but are not presumed to consume the entire fish. However, the data were collected this way to account for both the human health risk assessment and the ecological risk assessment. The risk assessment will assess exposure averaged over a harbor-wide basis rather than by river mile.

The rationale for the consumption rates is well documented in Section 3.5.10.6 of the revised risk assessment as follows:

The term “recreational fishers” is intended to encompass a range of the population while focusing on those who may fish on a more-or-less regular basis, and “subsistence fishers” to represent populations with high fish consumption rates, recognizing that fish are not an exclusive source of protein in their diet. Accordingly, 17.5 g/day is considered representative of a CT value for recreational fishers, and 73 g/day was selected as the RME value representing the higher-end consumption practices of recreational fishers. The consumption rate of 142 g/day represents a RME value for high fish consuming, or subsistence, fishers. No CT value was selected because the evaluations based on 17.5 g/day and 73 g/day inform the risks associated with lower consumption rates. Consumption rates for children aged 6 years and younger were calculated by assuming that their rate of fish consumption is approximately 42 percent of an adult, based on the ratio of child-to-adult consumption rates presented in the CRITFC Fish Consumption Survey. The corresponding rates that were used for children are 7 g/day, 31 g/day, and 60 g/day.

The rates of 17.5 g/day and 142 g/day represent the 90th and 99th percentiles, respectively, of per capita consumption of uncooked freshwater/estuarine finfish and shellfish by individuals (consumers and non-consumers) 18 or older, as reported in the Continuing Survey of Food Intakes by Individuals (CSFII) and described in EPA's Estimated Per Capita Fish Consumption in the United States. While the values are presented in terms of “uncooked weight,” it should not be construed to imply that the fish are consumed raw, as the consumption rates represent adjusted values to account for the amount of fish needed to prepare specific meals. No adjustments were made to contaminant concentrations in raw fish tissue because of the uncertainties associated with accounting for specific preparation and cooking practices.

The CSFII surveys recorded food consumption for two non-consecutive days. "Consumers only" were defined as individuals who ate fish at least once during the 2 day reporting period, individuals who reported not consuming any fish during the reporting period were designated as "non-consumers." For comparison, the 90th and 99th percentile consumption rates for consumers-only are 200 g/day and 506 g/day, respectively. Because of the short time period over which the survey is conducted, the results characterize the empirical distribution of average daily per capita consumption rather than describe true long-term average daily intakes. Although 17.5 g/day represents a 90th percentile value, it is considered an average consumption rate for sport fishers. Similarly, 142 g/day is considered to be representative of average consumption estimates for subsistence fishers when compared to upper percentile values for consumers only. However, the use of values representative of both non-consumers and consumers is appropriate as it accounts for the fact that some portion of the total diet of fish consumed may come from sources other than Portland Harbor. The consumption rate of 73 g/day is from a creel study conducted in the Columbia Slough, and represents the 95 percent upper confidence limit on the mean, where 75 percent of the mass of the total fish is consumed.

Assessment of resident fish only at the combined consumer and non-consumer consumption rates accounts for the fact that resident fish caught in Portland Harbor represent only a portion of the total individual diet of fish. Other sources of fish, either caught elsewhere or purchased may also comprise a portion of the total diet of fish, as well as non-resident fish caught within Portland Harbor.

In short, the proposal is:

Recreational Fishers
multi-species diet on both a harbor-wide and river mile scale (smallmouth bass is the surrogate on river mile scale)
17.5 g/day central tendency estimate, 73 g/day RME estimate (which is equivalent to 18.25 g/day for each of the four species of resident fish evaluated)
Fillet with skin consumption
no reduction in concentrations assumed due to preparation/cooking methods
30 year duration of exposure

Subsistence fishers
multi-species diet, evaluated harbor-wide only.
142 g/day consumption rate for RME estimate, no CT estimate
whole body and fillet consumption
no reduction in concentrations assumed due to preparation/cooking methods
30 year duration of exposure

If you have any questions regarding this email, please feel free to contact myself or Elizabeth Allen at 206-553-1807 or allen.elizabeth @epa.gov.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

(206)553-6705

(206)553-0124 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

From: Jennifer Woronets <jworonets@anchorqea.com>
To: Kristine Koch/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA
Cc: Jennifer Woronets <jworonets@anchorqea.com>, James McKenna <jim.mckenna@verdantllc.com>, "'LauraKennedy@KennedyJenks.com'" <LauraKennedy@KennedyJenks.com>, Elizabeth Allen/R10/USEPA/US@EPA, Lori Cora/R10/USEPA/US@EPA, Cami Grandinetti/R10/USEPA/US@EPA, Deb Yamamoto/R10/USEPA/US@EPA, Bob Wyatt <rjw@nwnatural.com>, Dave Livesay <dlivesay@gsiws.com>, David Ashton <david.ashton@portofportland.com>, "Fred G. Wolf (Frederick.wolf@total.com)" <Frederick.wolf@total.com>, "Fred Wolf email 2 Personal Privacy / Ex. 6 <frederickwolf@wamail.net>, Jennifer Woronets <jworonets@anchorqea.com>, "Jessica Hamilton (Jessica.Hamilton@portofportland.com)" <Jessica.Hamilton@portofportland.com>, "Jim McKenna (jim.mckenna@verdantllc.com)" <jim.mckenna@verdantllc.com>, "Karen Moynahan (karen.moynahan@portlandoregon.gov)" <karen.moynahan@portlandoregon.gov>, "Karen Traeger (karen.traeger@total.com)" <karen.traeger@total.com>, "Kim Cox (kim.cox@portlandoregon.gov)" <kim.cox@portlandoregon.gov>, "Madalinski, Kelly" <Kelly.Madalinski@portofportland.com>, Patty Dost <pdost@pearllegalgroup.com>, "Steve Parkinson (sparkinson@jzplaw.com)" <sparkinson@jzplaw.com>
Date: 08/29/2012 03:47 PM
Subject: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

Chip, Kristine,

Per our discussion during the informal dispute resolution meeting last week the LWG was asked to draft a proposal for developing the reasonable maximum exposure (RME) scenarios for recreational and subsistence fishing. Please see attached proposal for your review.

Please contact Bob Wyatt or Jim McKenna with any question.

Thank you,
Jen Woronets J
Anchor QEA, LLC
jworonets@anchorqea.com
421 SW Sixth Avenue, Suite 750
Portland, OR 97204
503-972-5014

ü Please consider the environment before printing this email.

The information is intended to be for the use of the individual or entity named above. If you are not the intended recipient, please be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. If you have received this electronic transmission in error, please notify us by electronic mail at jworonets@anchorqea.com

[attachment "2012-08-29 RME Fish Consumption Proposal.pdf" deleted by Kristine Koch/R10/USEPA/US]

To: CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
From: CN=Elizabeth Allen/OU=R10/O=USEPA/C=US
Sent: Tue 10/9/2012 11:16:49 PM
Subject: Fw: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

This is what we sent the LWG in September. Their dispute brief makes mention of our proposal, but provides no details and it does not appear to be presented as one of their tabs. I think the justification for our assumptions is well described in this email, and the assumptions/justifications for some of the other arguments, such as exposure concentration, exposure duration, use of concentration representing uncooked fish, and not accounting for changes in concentrations due to preparation and cooking are already well described in our June 22 revised BHHRA, and still present in the Sept 17 version. Other than clarifying that we propose deleting adult- and child-only cancer risk estimates, adult- and combined adult+child hazard evaluations, I don't see what else we'd argue. Once we make a cogent argument that a river mile is a reasonable exposure area, it follows by definition that we'd have RME estimates for each exposure area. For heaven's sake, they don't argue that that type of analysis is "contrary to EPA guidance and policy" when it's done for the sediment exposure analyses, and there is no basis in logic for any argument that there can't be multiple RMEs in the risk assessment.

----- Forwarded by Elizabeth Allen/R10/USEPA/US on 10/09/2012 04:06 PM -----

From: Kristine Koch/R10/USEPA/US
To: Jennifer Woronets <jworonets@anchorqea.com>, Bob Wyatt <rjw@nwnatural.com>,
Cc: Cami Grandinetti/R10/USEPA/US@EPA, Chip Humphrey/R10/USEPA/US@EPA, David Ashton <david.ashton@portofportland.com>, Deb Yamamoto/R10/USEPA/US@EPA, Dave Livesay <dlivesay@gsiws.com>, Elizabeth Allen/R10/USEPA/US@EPA, "Fred Wolf email 2 Personal Privacy / Ex. 6 Fred G. Wolf (Frederick.wolf@total.com)" <Frederick.wolf@total.com>, "Jessica Hamilton (Jessica.Hamilton@portofportland.com)" <Jessica.Hamilton@portofportland.com>, James McKenna <jim.mckenna@verdantllc.com>, "Karen Moynahan (karen.moynahan@portlandoregon.gov)" <karen.moynahan@portlandoregon.gov>, "Karen Traeger (karen.traeger@total.com)" <karen.traeger@total.com>, "Madalinski, Kelly" <Kelly.Madalinski@portofportland.com>, "Kim Cox (kim.cox@portlandoregon.gov)" <kim.cox@portlandoregon.gov>, "'LauraKennedy@KennedyJenks.com'" <LauraKennedy@KennedyJenks.com>, Lori Cora/R10/USEPA/US@EPA, Patty Dost <pdost@pearllegalgroup.com>, "Steve Parkinson (sparkinson@jzplaw.com)" <sparkinson@jzplaw.com>, fleming.sheila@epa.gov
Date: 09/11/2012 03:34 PM
Subject: Re: Reasonable Maximum Exposure (RME) Proposal for the Baseline Human Health Risk Assessment

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whole body and fillet consumption
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30 year duration of exposure

If you have any questions regarding this email, please feel free to contact myself or Elizabeth Allen at 206-553-1807 or allen.elizabeth @epa.gov.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

(206)553-6705
(206)553-0124 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

To: CN=Deb Yamamoto/OU=R10/O=USEPA/C=US@EPA[]
Cc: CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA;CN=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA[]; N=Lori Cora/OU=R10/O=USEPA/C=US@EPA;CN=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA[]; N=Sean Sheldrake/OU=R10/O=USEPA/C=US@EPA[]
From: CN=Chip Humphrey/OU=R10/O=USEPA/C=US
Sent: Mon 10/22/2012 6:32:24 PM
Subject: Briefing and talking points for Dennis
DM Briefing & Talkng Points 102212.doc

Deb - here the latest team draft of the briefing paper (status, issues & talking points) for Dennis. Will keep tweaking based on comments in advance of the briefing Wednesday morning. One thing to consider is sorting the messages into those we want Dennis to deliver and others that he'll have ready if issues come up in the discussions - like complaints about previous agreements & what LWG views as EPA changing direction. Our dispute paper has some good language that we can paraphrase and add to the current list.

Chip

To: CN=Joanne Moore/OU=R10/O=USEPA/C=US@EPA;CN=Kristine Koch/OU=R10/O=USEPA/C=US@EPA[]; N=Kristine Koch/OU=R10/O=USEPA/C=US@EPA[]
Cc: []
From: CN=Michel Rodriguez/OU=R10/O=USEPA/C=US
Sent: Tue 11/6/2012 3:26:04 PM
Subject: Briefing: Portland Harbor SF Site
Portland Harbor Yakama Nation request for G2G Oct 2012.pdf
Portland Harbor RA briefing Oct 2012.docx
(embedded image)
(embedded image)

Jim and Michel,

Below are some background documents regarding the Portland Harbor SF Site. We gave a briefing to the RA a couple of weeks ago so the below file has current information. I also attached the letter from Yakama Nation requesting G2G consultation.

I still need to schedule a 20 minute meeting with Jim (this week). It will be Kristine Koch and I and we're thinking at 11am on Nov 8th (Thursday) would work. I left Michel a voicemail about this so I'll wait to hear.

There is also the prep meeting on Dec 19th at 3pm that Jim Woods needs to be included on. Matthew Magorrian sent the meeting invite and it'd be good to include Jim in that (in case of changes down the road). Thanks much, Joanne

Joanne Moore, SF Tribal Specialist
US Environmental Protection Agency, Region 10
1200 6th Avenue, Suite 900, MS ECL-110
Seattle, WA 98101
Tel. (206) 553-0310
Fax. (206) 553-0124
email: moore.joanne@epa.gov

From: CN=Kristine Koch/OU=R10/O=USEPA/C=US
Sent: Wed 11/7/2012 10:02:48 PM
Subject: Portland Harbor Project Management Prep
Portland Harbor Project Planning Meeting Agenda 11-7-2012.docx
koch_Road to ROD Activities.docx
Portland Harbor Schedule.xlsx

Need to discuss agenda topics, who should attend which parts, anticipated outcomes

To: OSWER OSRTI RRB[]
Cc: CN=Eva Davis/OU=ADA/O=USEPA/C=US@EPA[]
Bcc: []
From: CN=Amy Legare/OU=DC/O=USEPA/C=US
Sent: Tue 10/2/2012 5:58:59 PM
Subject: NRRB - November meeting and 2013 calendar
FY 2013 NRRB Meeting Calendar.docx

We will be meeting the week of November 13-16 in San Francisco. We will be reviewing Montrose (R9), 68th Street (R3), and possible Sauget Area 2 (R5). SA2 is very close to $25M and may drop below. Therefore I can't tell you the exact dates of the meeting or what site will be on what day. I booked my travel to fly on Monday (yes, the holiday) and Friday, 4 nights in the hotel.

We are going to R9 because the Montrose RPM is just coming off maternity leave.

Once again hotels at the per diem ($155) are few and far between. There is no room block.

I used GovTrip to get a room for $225 at the Palace Hotel on New Montgomery Street. This is about a 15 minute walk to the warehouse - 674 Harrison St, SF CA 94107. Yes we have the warehouse reserved for us.

You may also give www.fedrooms.com a try. Last I looked there were rooms at $155 available within a mile of the warehouse.

I have only one site charging number: Montrose 0926BD03. I'll send the rest as soon as I get it/them.

As soon as I get word on SA2 I will let you know.

Amy R. Legare
U.S. Environmental Protection Agency
OSWER/OSRTI/ARD/SARDB
5828 Potomac Yard South
MC 5204P
703-347-0124

October 2, 2012

FY 2013 NRRB Meeting Calendar

Planned Reviews

November 13-16, 2012, San Francisco
68th Street Dump – R3
Sauget Area 2 – R5 (may be below $25M)
Montrose – R9

December 11-13, 2012, HQ
Passaic River – R2
American Creosote, FL – R4

January 28 – February 1, 2013
Casmalia – R9

April 22 – 26, 2013
Nuclear Metals – R1

July 22 – 26, 2013

Future

Cayuga – R2
LCP – R2
Quanta Resources OU2 (the river) – R2
Ringwood Mine – R2
Olin – R4
Libby OU4 – R8
Stringfellow – R9
Portland Harbor – R10 (with CSTAG, 2-day meeting)
Quendall Terminals – R10

To: "Silvina Fonseca" [Fonseca.Silvina@epa.gov]; Amy Legare" [legare.amy@epa.gov]
From: CN=Doug Ammon/OU=DC/O=USEPA/C=US
Sent: Thur 7/26/2012 2:36:35 PM
Subject: Fw: Just so you have...
2012-07-23 LWG Notice of Objection and Request for Dispute Resolution.pdf
2012-07-23 Table 1 Deficiencies Identified by EPA in its June 22, 2012 Cover Letter.pdf
2012-07-23 Table 2 General Categories of LWG Objections to EPA June 22, 2012 Revisions.pdf
2012-07-23 Table of Contents For Dispute Resolution Package.pdf
elaws@crowell.com
www.crowell.com

Fyi only
DCA sent by Blackberry

----- Original Message -----
From: James Woolford
Sent: 07/26/2012 10:33 AM EDT
To: Doug Ammon; Bruce Means; Phyllis Anderson; Barnes Johnson
Subject: Just so you have...
No action - just situational awareness.

James Woolford, Director
Office of Superfund Remediation and Technology Innovation (OSRTI)
Office of Solid Waste and Emergency Response (OSWER)
U.S. Environmental Protection Agency (US EPA)
Office: 703-603-8960
Fax: 703-603-9146

woolford.james@epa.gov
----- Forwarded by James Woolford/DC/USEPA/US on 07/26/2012 10:32 AM -----

From: "Laws, Elliott" <ELaws@crowell.com>
To: James Woolford/DC/USEPA/US@EPA
Date: 07/26/2012 10:30 AM
Subject:

Jim -- as I mentioned -- here is the dispute resolution material the LWG sent to Region X. Tables 1 and 2 lay out where the LWG had previous agreements with Region X that were then changed or ignored by the Region. They basically want the non-compliance determination and the directed comments withdrawn as neither was justified in light of previous agreements with the Region (sure the Region can change its mind -- but can it make an agreement, have the PRPs act on it then just say, "oh, we changed our minds..and by the way you're now not in compliance.."?) -- and then sit down and discuss the specific issues that the Region really feels are necessary.

I think their first meeting is Tuesday. I know you guys won't be involved but I'm concerned that the staff level discussions won't yield much as these are the same people who sent the non-compliance and directed comments....

Thnx,

Elliott

Elliott P. Laws
Crowell & Moring LLP
1001 Pennsylvania, Avenue, NW | Washington, DC 20004
P - 202-624-2798 | F - 202-628-5116
elaws@crowell.com | www.crowell.com
This message contains privileged and confidential information. IF IT WAS SENT TO YOU BY MISTAKE, DO NOT READ IT. Instead, please notify the sender (or postmaster@crowell.com) by reply e-mail, and delete this e-mail. Unauthorized dissemination, forwarding or copying of this e-mail is strictly prohibited.

To: Woolford, James[Woolford.James@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Cooper, DavidE[Cooper.DavidE@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]; Scozzafava, MichaelE[Scozzafava.MichaelE@epa.gov]; Richardson, RobinH[Richardson.RobinH@epa.gov]
From: Ells, Steve
Sent: Mon 12/8/2014 2:58:21 PM
Subject: RE: Monday plans/talking points
RA talking points Dec 8 2014 PH Execs mtg SJE.docx

Jim, please call with any questions 703 603-8822.

From: Woolford, James
Sent: Sunday, December 07, 2014 6:39 AM
To: Stalcup, Dana; Cooper, DavidE; Ammon, Doug; Scozzafava, MichaelE; Ells, Steve; Richardson, RobinH
Subject: FW: Monday plans/talking points

ARD. Can you all look over and get me comments by 11 Monday AM.

They compare/ contrast LDW and PH. Can we do so with other rivers/sites?

Jim Woolford, Director
Office of Superfund Remediation & Technology Innovation
US EPA

Sent from my Windows Phone
Please excuse typos

From: Cohen, Lori
Sent: 12/5/2014 7:05 PM
To: McLerran, Dennis; Woolford, James
Cc: Tyler, Kendra; Magorrian, Matthew; Brave, Jennifer; Barber, Anthony; Albright, Rick
Subject: Monday plans/talking points

Jim and Dennis,

Just a quick note to confirm our plans on Monday.

Jim arrives Sunday; Dennis and I will be on a 10am flight to Portland on Monday. We should arrive at the Operations Office by 11:45am or so. We can grab a sandwich for lunch.

12:30- 1:30pm: Meeting with the EPA team by phone from 12:30-1:30pm to review talking points/issues for the afternoon meetings.

1:30- 2pm: Meeting with the State, Dick Pedersen and Kevin Parrett. We will prep for Exec meeting as needed and provide update on work with Bill Ross. (at Oregon Ops Office)

2:30-4pm Meet with Portland Harbor Executives (See attached Agenda with meeting participants, and RA Talking Points)

Dennis leaves for airport

4:30-5:20pm Meet with Tribal representatives – Lori and Jim- at Operations Office

5:20-6pm Meet with Community members – Lori and Jim at Operations Office

8pm Lori and Jim on flight to Seattle.

RA Talking Points

Portland Harbor Executives Meeting – Dec 8, 2014

EPA Updates on Portland Harbor Project

<u>Planned Milestones/ Modifications to FS Process</u>

RI – target agreement on issues by end of the year; dispute resolution by end of 2014; completion/document production, early 2015

FS – revising FS process with LWG; appreciate their openness to make process more efficient

NRRB – target date Nov 2015 (two months before, parties will get package to review and comment on; 30 day comment period; this is standard for all sites)

<u>Sediment Site Cleanups – Common Elements</u>

All sediment sites, including the Duwamish, are similar in that:

- Our policy is to address ongoing sources of contamination before initiating cleanup of contaminated sediments. We're doing that at Duwamish, we are doing this at Portland Harbor as we have at our other Superfund sites with contaminated sediments. The State plays a key role in this and we value this important partnership.
- We generally select a combination of technologies, such as dredging, capping, and enhanced natural recovery rather than just one technology, to address sediment contamination.
- Remedies can include on site disposal or off-site disposal of contaminated sediments – we consider the tradeoffs.
- River cleanups in heavily industrialized areas are complex and no doubt expensive. We follow the CERCLA nine criteria in making our decisions (see last page for list if questioned). Try to strike the right balance in our cleanup decisions. Need to consider the various uses of the sits – industry, recreation, fishing, and ecological significance.
- We tailor cleanup plans to address the specific needs at each site.
- At many large sites, we have governments involved as PRPs, and as leaders in the community who can be instrumental in the cleanup.

There are some aspects that are more unique to Duwamish:

- We have worked with all parties involved with the cleanup to clean up the most contaminated areas before issuing the ROD. This has been done at many, but not all Superfund cleanups. A little different here in Portland, only two early action (relatively small but still important) clean ups have accomplished.
- We heard from key parties in the Lower Duwamish that they wanted a final ROD. Therefore, ROD has Remedial Action Goals (RALs that determine where active cleanup is required) and long term cleanup goals.

- RALs are practical and achievable.
- Long term goals for surface water and sediments are included in the ROD; parties will be required to monitor to see if these long term goals can be met and if not we would consider if additional work needed under CERCLA (under a separate decision) or if those standards should be waived in the future.

- Washington state has stringent cleanup laws, like their sediment management standards, which are an important factor in our selection of sediment cleanup levels at Washington sites.
- Carbon amendment pilot – for application in ENR areas. Technology that has been used in the Grasse River, NY and Hunter Point in CA.

<u>Some key differences between PH and LDW:</u>

[*Dennis bottom line is:* Willamette is a larger river, there is more complexity, remedy to be more costly – here are some points to give that message without being quite so blunt]:

- The hydrodynamics of the two rivers differ which make environmental conditions for cleanup differ. The Lower Willamette is a much bigger river than the Lower Duwamish, with higher flow rates. The Lower Duwamish has lower flows and greater deposition than the Lower Willamette which makes the Lower Duwamish more conducive to Monitored Natural Recovery and Enhanced Monitored Natural Recovery remedies.
- The larger size of the Willamette also means more water depth, more debris, and larger flood to dry condition estuarine river stages, which creates contaminated groundwater plume complexities, and challenges for implementing capping and dredging techniques.
- Portland Harbor has several highly contaminated groundwater plumes that are impacting the river. In LDW, the biggest source control concern is stormwater.
- The Portland Harbor Site has more hot spots than the Lower Duwamish. In Portland Harbor, the hot spots are not all PCBs: there are also hot spots of dioxin/furans, DDx, PAHs.
- Portland Harbor is larger, more interested parties involved. The more stakeholders involved means the more voices with differing opinions that need to be considered.

-

CERCLA Nine Criteria

Threshold criteria:

- overall protection of human health and the environment;
- compliance with Applicable or Relevant and Appropriate Requirements(ARARs)

Primary balancing criteria:

- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume;
- short-term effectiveness;
- implementability;
- cost;

Modifying criteria (fully considered after public comment):

- State acceptance; and
- community acceptance.

The alternatives are analyzed individually against each criterion and then compared against one another to determine their respective strengths and weaknesses and to identify the key trade-offs that must be balanced for the site. The results of the detailed analysis are summarized so that an appropriate remedy consistent with CERCLA can be selected.

To: Woolford, James[Woolford.James@epa.gov]; Richardson, RobinH[Richardson.RobinH@epa.gov]
Cc: Ammon, Doug[Ammon.Doug@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Cooper, DavidE[Cooper.DavidE@epa.gov]; Frame, Alicia[Frame.Alicia@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Lambert, Matthew[Lambert.Matthew@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]
From: Scozzafava, MichaelE
Sent: Tue 11/18/2014 2:13:11 PM
Subject: SPB Review of PDX Harbor Background Issue
Portland Harbor -- summary and detailed comments_final.docx

Jim,

As discussed, I am providing a paper that reviews the LWG's concerns about the statistical methods used to caculate background. This paper was authored primarily by Alicia Frame and with input from Steve Ells and Matt Lambert.

The paper provides a summary of our key points up front and more detail on each issue later in the document.

We are happy to discuss this analysis with you before you leave for Portland.

Mike

To: Ammon, Doug[Ammon.Doug@epa.gov]
Cc: Yamamoto, Deb[Yamamoto.Deb@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]; Woolford, James[Woolford.James@epa.gov]; Levine, Carolyn[Levine.Carolyn@epa.gov]; Schuster, Cindy[Schuster.Cindy@epa.gov]
From: Cohen, Lori
Sent: Tue 11/4/2014 12:03:13 AM
Subject: RE: Portland Harbor - draft congressional update comments
Cong del PH update 11 3 2014.docx

Thanks for these suggestions. I made the changes… a couple of things to note:

Jim notes questioned whether the general public would be asked for input during the NRRB process and my understanding is that we typically only have the CAG and participating PRPs, Tribes and state the opportunity to comment during NRRB. Correct?

Also, yes the Arkema work is under an Order for EE/CA but they are interested in collecting data and having us use if for RI/FS evaluation…. hence a dispute.

I think I addressed the other comments although not sure what to add about the importance of the RM 11 E work – basically shows some sampling got done.

If OSRTI is ok with this version, please let Carolyn know!

From: Ammon, Doug
Sent: Monday, November 03, 2014 2:52 PM
To: Cohen, Lori
Cc: Yamamoto, Deb; Fonseca, Silvina; Woolford, James
Subject: Portland Harbor - draft congressional update comments

Lori,

Attached are Jim's comments. Thanks.

From: EZTech_Printer [mailto:EZTek@epa.gov]
Sent: Monday, November 03, 2014 5:44 PM
To: Ammon, Doug
Subject: Portland harbor update comments on draft

Portland Harbor Superfund Site/ EPA Update for Congressional Delegation –November 3, 2014

We look forward to discussing this update with you on November 12, 2014.

Key Milestone:

EPA is on track to meet a key milestone in fall 2015, when we submit our initial cleanup proposal for the site to the National Remedy Review Board and the Contaminated Sediments Advisory Group. At that time, the Lower Willamette Group, the Citizens Advisory Group, tribes, and State and other agency partners will be able to comment on EPA's initial cleanup proposal.

Remedial Investigation/Feasibility Study:

These documents will provide the foundation for EPA's cleanup proposal. The RI/FS documents were written by the LWG but are being modified by EPA in coordination with the LWG, Tribes and agency partners to be consistent with the Superfund law, EPA regulations and EPA guidance. This will address deficiencies previously identified by EPA. The LWG filed a formal dispute with regard to EPA's calculation of background levels at the site; the dispute is under EPA review. Nevertheless, work continues and our goal is to complete the RI this calendar year. Concurrently, work is progressing to modify the Feasibility Study; EPA and the LWG are discussing options to improve the unique, collaborative process we are using to finalize this document.

State Actions:

ODEQ, as the lead agency for source control, is preparing a summary report that will be submitted to EPA in November for review of the status of source control. DEQ is planning outreach to the community on source control progress.

ODEQ sent EPA a letter outlining some concerns about the pace of the project and project management, and EPA responded. (The letters are attached). The Agencies are engaging in a series of facilitated meetings to discuss/resolve the DEQ concerns. The State has proposed taking on some sediment cleanup projects prior to EPA's cleanup decision; this could create some consistency issues that we are discussing with the State, which will be weighed against the possibility of advantages of overall project sequencing and early exposure reduction.

Outreach:

EPA continues to reach out to interested community members and participate in meetings hosted by the CAG. This past summer, EPA gave presentations during bus tours of the site sponsored by Groundwork Portland, a non-profit organization that advances environmental and social justice for disadvantaged communities. EPA collaborated with the Port of Portland on its podcast series to be launched in November that provides many perspectives on the project.

Early actions:

Arkema has filed a formal dispute under the legal agreement for early action cleanup of contaminated sediment adjacent to its facility which is under EPA review. Arkema is arguing to have additional data collected for the site and incorporated into the RI/FS. Collecting this data would likely delay the overall project schedule.

RM 11E data collection was completed in October 2014 when the final samples were collected by divers. Data is under review now which will feed into the RI/FS and remedial design.

Gasco/Siltronic work continues to focus on pre-design data collection, which included groundwater/diver collected data to pinpoint areas where upland hydraulic control can be improved and to support future design of the remedy.

Upcoming Executive Level Meetings:

On November 24, 2014, EPA Regional Administrator Dennis McLerran and HQ Director OSRTI Jim Woolford will attend the meeting to be hosted by Congressman Blumenauer and the Governor.

On December 8, 2014, EPA Regional Administrator Dennis McLerran and HQ Director OSRTI Jim Woolford will attend the meeting with the LWG Executives, and meetings with Tribal representatives and the CAG to provide project updates and continue dialogue on key issues of concern.

To: Frame, Alicia[Frame.Alicia@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Scozzafava, MichaelE[Scozzafava.MichaelE@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]
From: Ells, Steve
Sent: Mon 11/3/2014 7:35:27 PM
Subject: FW: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI
2014_09_03 EPA Response to LWG Dispute on Background.pdf
2014-10-03 EPA Position Memo.pdf

Alicia, here is the Region's response for you to review.

From: Yamamoto, Deb
Sent: Monday, November 03, 2014 2:32 PM
To: Ells, Steve
Subject: FW: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI

Steve,

The first attachment is our response to the LWG's dispute over background in Section 7 of the Portland Harbor RI. The second attachment is just the cover memo To Rick Albright. FYI, the LWG has responded to our dispute statement. I will forward that next.

Deb

From: Koch, Kristine
Sent: Friday, October 03, 2014 4:29 PM
To: Bob Wyatt (rjw@nwnatural.com); Jim McKenna (jim.mckenna@verdantllc.com)
Cc: Jennifer Woronets; Yamamoto, Deb; Cora, Lori; Cohen, Lori; Sheldrake, Sean; Allen, Elizabeth
Subject: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI

Bob –

I have attached an electronic copy of the EPA's response to the LWG's Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7. A DVD containing the response and relevant reference materials has been mailed overnight to your office. Due to the size of the exhibits, EPA is only providing a copy of the transmittal letter and response in this email. I will email Jen Woronets as many of the exhibits as possible today.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

(206)553-6705
(206)553-0124 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

To: Stalcup, Dana[Stalcup.Dana@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]; Hovis, Jennifer[Hovis.Jennifer@epa.gov]
Cc: Poore, Christine[Poore.Christine@epa.gov]; Gartner, Lois[Gartner.Lois@epa.gov]; Fitz-James, Schatzi[Fitz-James.Schatzi@epa.gov]; Fine, Ellyn[Fine.Ellyn@epa.gov]
From: Dailey, Anne
Sent: Wed 6/1/2016 1:55:12 PM
Subject: OSRTI Hot Tribal Sites sheet
OSRTI Tribal Hot Sites - NTOC 6-1-16.docx

Hello –

As discussed, attached is the OSRTI Tribal Hot Sites sheet for National Tribal Operations Committee (NTOC) meeting which will be held next week. **Please let me know if you have any comments ASAP – we need to get this over to Jessica Snyder, OLEM by 1 pm today.** Sorry for the quick turn-around but info from 4 regions just rolled in yesterday.

Thanks very much!! Anne and Christine

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

DELIBERATIVE – DO NOT RELEASE – INTERNAL EPA WORK PRODUCT

OSRTI "HOT" TRIBAL SITES UPDATE (June 1, 2016)

The following Superfund sites are included in this update:

Nonresponsive

R10 - Nonresponsive Portland Harbor, Nonresponsive

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<u>Portland Harbor (Region 10)</u>

Who may bring up the issue: The Yakama Tribe, the Nez Perce Tribe, the Confederated Tribes of the Siletz, Grand Rhonde, Warm Springs, and Umatilla

Issue: Consultation is underway with these six Tribes on the upcoming remedy decision for Portland Harbor. Since the EPA Administrator will be signing the remedy decision, there have been requests for consultation with the Administrator.

- The Portland Harbor Site is an enforcement lead site that spans the lower 10 miles of the Willamette River in Portland, Oregon. Although the site is not located on any of the Tribes reservations, it is within or impacts the Usual and Accustomed Areas for these tribes.
- EPA has continued to coordinate with the six Federally Recognized Tribes for the RI/FS process. The Tribes also continue to participate in the technical oversight group (with EPA and other co-regulators).
- The Region 10 Regional Administrator and National Program Director meet with the Tribes 2-3 times a year. The last meeting of these meetings was held March 31, 2016.
- EPA follows the national and Regional policy on consultation with the Tribes which states that EPA must consult with the Tribes on any remedy decision. For Portland Harbor, the Region offered consultation to all six Federally Recognized Tribes prior to issuing the Proposed Plan, which is EPA's proposed cleanup of the site. The Region 10 Administrator and Director for the Office of Superfund Remediation and Technology Innovation have completed tribal consultations with Nez Perce, Siletz, Grand Ronde, Yakama, and Umatilla. These consultation meetings covered the remedy EPA is considering for its Proposed Plan and allowed the EPA to have meaningful dialogues with the Tribal Councils on their concerns related to the cleanup of Portland Harbor.
- EPA recently announced that the Proposed Plan will be released on June 8 and the public comment period will start on June 9 and conclude on August 8.
- Once the Proposed Plan has been issued and Tribes have had a chance to review the proposal, EPA offers a second round of Government to Government consultations. This will allow a dialogue that addresses the specific cleanup approach described in the Proposed Plan. We are

currently working to schedule these consultations.

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To: Dailey, Anne[Dailey.Anne@epa.gov]; Poore, Christine[Poore.Christine@epa.gov]
From: Atkins, Blake
Sent: Tue 5/31/2016 8:16:25 PM
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10
OSRTI Tribal Hot Sites 11-3-15-Mathy v6 - Purcell Edits Region 6 without track changes.docx
OSRTI Tribal Hot Sites 11-3-15-Mathy v6 - Purcell Edits Region 6.docx

Here's one of three updates…

From: Purcell, Mark
Sent: Tuesday, May 31, 2016 3:01 PM
To: Atkins, Blake <Atkins.Blake@epa.gov>
Subject: RE: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10

Blake,

I have made revisions to the Hot Tribal Sites updates for North Railroad Avenue Plume. The two files attached show the revisions (one file without track changes)

Mark

From: Atkins, Blake
Sent: Tuesday, May 31, 2016 1:39 PM
To: Sanchez, Petra <sanchez.petra@epa.gov>; Purcell, Mark <purcell.mark@epa.gov>; Casanova, Rafael <Casanova.Rafael@epa.gov>
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10
Importance: High

Please update as appropriate, evidently needed now.

Thanks.

Blake

From: Poore, Christine
Sent: Tuesday, May 31, 2016 1:35 PM
To: Atkins, Blake <Atkins.Blake@epa.gov>
Cc: Dailey, Anne <Dailey.Anne@epa.gov>
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10
Importance: High

Hi Blake,

Anne Dailey and I are tribal coordinators in OSRTI HQ. We're in need of updates on three sites that are all within your section. Unfortunately, LaDonna Turner, who we usually coordinate through, is out of the office. Can you please ask the RPMs for the three sites below to update the attached language and provide to Anne and me as soon as possible? This is due to OLEM management by tomorrow. Sorry for the quick turnaround!

Christine

From: Dailey, Anne
Sent: Friday, May 27, 2016 11:16 AM
To: Poore, Christine <Poore.Christine@epa.gov>; OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Snyder, Jessica <Snyder.Jessica@epa.gov>
Subject: RE: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10

Hello All –

First, a big thank you to Regions 1, 2, 5 and 9 for providing your hot site updates by the due date!

WE URGENTLY NEED THE UPDATES FOR THE FOLLOWING SITES:

R6 – Jackpile-Paguate Uranium Mine, North Railroad Plume, Tar Creek

R7 - Cherokee County

R8 - Darrow Freezeout Triangle Site, Smurfit-Stone Mill Frenchtown

R10 - Lower Duwamish Waterway, Portland Harbor, Upper Columbia River, Eastern Michaud Flats (FMC OU/Simplot OU), Gay Mine, Makah Reservation Warmhouse Beach Dump

PLEASE SEND THESE UPDATES ASAP!!! WE NEED TO SUBMIT UPDATES TODAY TO OLEM FOR PREPARATION OF BRIEFING MATERIASL FOR MATHY STANISLAUS AND THE ADMINISTRATOR.

Thank you very much for your help! Anne and Christine

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

From: Poore, Christine
Sent: Wednesday, May 25, 2016 8:39 AM
To: OLEM OSRTI SF Regional Tribal Coordinators

<OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please

Hi Everyone,

Thanks to those who have provided updates! For those who have not yet had a chance, please provide updates by COB tomorrow.

Thanks!

Christine and Anne

From: Dailey, Anne
Sent: Tuesday, May 17, 2016 10:33 AM
To: OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Ammon, Doug <Ammon.Doug@epa.gov>; Hovis, Jennifer <Hovis.Jennifer@epa.gov>
Subject: Hot Tribal Sites Updates Needed - Due May 26 COB Please

Hello Superfund Regional Tribal Coordinators –

Once again we need to update the OSRTI "hot" tribal sites information sheet in anticipation of the upcoming National Tribal Operations Committee meeting on June 8 -9, 2016. The NOTC is comprised of 20 tribal leaders and EPA senior leadership (co-chaired by EPA Administrator McCarthy and typically office directors and regional administrators participate in person or by video conference).

➔To hopefully make this as painless as possible -- attached is the most recent version from November 2015 (prepared for the White House Tribal Summit) that can be used as a starting point.

➔ Per request from OLEM -- since there is a renewed focus on lead, if lead is a contaminant of concern at the "hot" site – please include any relevant information about the lead cleanup. At this time, do not add any new sites just because lead is a contaminant of concern.

➔Please provide your regional tribal "hot" site updates to both Christine Poore and me by COB

Thursday, May 26, 2016.

Thank you again for your help with this!! Anne Dailey and Christine Poore (OSRTI Superfund Tribal Coordinators)

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

DRAFT OSRTI "HOT" TRIBAL SITES UPDATE (draft November 3, 2015)

Nonresponsive

R10 - Nonresponsive Portland Harbor, Nonresponsive

Nonresponsive

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<u>Portland Harbor (Region 10)</u>

Who may bring up the issue: The Yakama Tribe, the Nez Perce Tribe, the Confederated Tribes of the Siletz, Grand Rhonde, Warm Springs, and Umatilla

Issue: These six Tribes may request consultation with the EPA Administrator on the upcoming remedy decision for Portland Harbor since the Administrator is signing the decision.

- The Portland Harbor Site is an enforcement lead site that spans the lower 10 miles of the Willamette River in Portland, Oregon. Although the site is not located on any of the Tribes reservations, it is within or impacts the Usual and Accustomed Areas for these tribes.
- There is a final Remedial Investigation report for the site and EPA is currently modifying the Potentially Responsible Parties Feasibility Study.
- EPA released the modified sections of the Feasibility Study in August, 2015.
- The site team is preparing for a review by the National Remedy Review Board and Contaminated Sediment Technical Advisory Group in November of this year.
- EPA has requested government-to-government consultation with the six Tribes to occur between November 2015 and February 2016.

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To: Dailey, Anne[Dailey.Anne@epa.gov]
Cc: Jennings, Jannine[Jennings.Jannine@epa.gov]; Sheldrake, Beth[sheldrake.beth@epa.gov]
From: Williams, Jonathan
Sent: Tue 5/31/2016 7:56:10 PM
Subject: RE: URGENT!!!! Tribal hot site updates needed NOW
OSRTI Tribal Hot Sites 11-3-15-Mathy v6EMF Update 5-30-16. FMC edits.docx

Anne:

Nonresponsive

Jonathan Williams, LHG

Remedial Project Manager

U.S. Environmental Protection Agency

1200 Sixth Avenue, Suite 900, ECL-122

Seattle, WA 98101

Telephone: (206) 553-1369

E-mail: williams.jonathan@epa.gov

From: Jennings, Jannine
Sent: Tuesday, May 31, 2016 10:29 AM
To: Sheldrake, Beth <sheldrake.beth@epa.gov>; Dailey, Anne <Dailey.Anne@epa.gov>
Cc: Williams, Jonathan <Williams.Jonathan@epa.gov>
Subject: RE: URGENT!!!! Tribal hot site updates needed NOW

Anne,

Nonresponsive

If you have any questions, please feel free to give me a call.

Jannine

Jannine Jennings

EPA Remedial Project Manager

206-553-2724

jennings.jannine@epa.gov

From: Sheldrake, Beth
Sent: Tuesday, May 31, 2016 9:29 AM
To: Hale, Elly <Hale.Elly@epa.gov>; Chu Rebecca <Chu.Rebecca@epa.gov>; Peterson, Piper <Peterson.Piper@epa.gov>; Buelow, Laura <Buelow.Laura@epa.gov>; Zhen, Davis <Zhen.Davis@epa.gov>; Grandinetti, Cami <Grandinetti.Cami@epa.gov>; Williams, Jonathan <Williams.Jonathan@epa.gov>; Jennings, Jannine <Jennings.Jannine@epa.gov>; Wallace, Joe <Wallace.Joe@epa.gov>

Cc: Blocker, Shawn <Blocker.Shawn@epa.gov>; Faulk, Dennis <Faulk.Dennis@epa.gov>; Moore, Joanne <Moore.Joanne@epa.gov>; Dailey, Anne <Dailey.Anne@epa.gov>
Subject: URGENT!!!! Tribal hot site updates needed NOW

All – Apparently R10 is a bit behind the ball on this and HQ needs our tribal hot site updates within the next couple of hours. Please send updates directly to Anne Dailey as soon as possible.

Sorry for the fire drill….

R10 - Nonresponsive Portland Harbor (Cami/Davis), Nonresponsive

Nonresponsive

Beth Sheldrake | Unit Manager

U.S. Environmental Protection Agency | Region 10

Office of Environmental Cleanup

Superfund Site Cleanup Unit #1

p: 206.553.0220 | c: 206.890-1827 | sheldrake.beth@epa.gov

From: Dailey, Anne
Sent: Tuesday, May 31, 2016 6:49 AM
To: Moore, Joanne <Moore.Joanne@epa.gov>; Sheldrake, Beth <sheldrake.beth@epa.gov>
Cc: Poore, Christine <Poore.Christine@epa.gov>
Subject: RE: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10

Hello Beth and Joanne –

Per voicemail to Beth this morning, since Beth gets in early and has been helpful wrangling some of these tribal hot sites updates in the past and since time is of the essence….I am forwarding this email to Beth.

Any help with the Region 10 tribal hot sites updates would be greatly appreciated!! Thank you!! - Anne

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

From: Dailey, Anne
Sent: Friday, May 27, 2016 8:16 AM
To: Poore, Christine <Poore.Christine@epa.gov>; OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Snyder, Jessica <Snyder.Jessica@epa.gov>
Subject: RE: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10

Hello All –

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R7 - Cherokee County

R8 - Darrow Freezeout Triangle Site, Smurfit-Stone Mill Frenchtown

R10 - Lower Duwamish Waterway, Portland Harbor, Upper Columbia River, Eastern Michaud Flats (FMC OU/Simplot OU), Gay Mine, Makah Reservation Warmhouse Beach Dump

PLEASE SEND THESE UPDATES ASAP!!! WE NEED TO SUBMIT UPDATES TODAY TO OLEM FOR PREPARATION OF BRIEFING MATERIASL FOR MATHY STANISLAUS AND THE ADMINISTRATOR.

Thank you very much for your help! Anne and Christine

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

From: Poore, Christine
Sent: Wednesday, May 25, 2016 8:39 AM
To: OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please

Hi Everyone,

Thanks to those who have provided updates! For those who have not yet had a chance, please provide updates by COB tomorrow.

Thanks!

Christine and Anne

From: Dailey, Anne
Sent: Tuesday, May 17, 2016 10:33 AM
To: OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Ammon, Doug <Ammon.Doug@epa.gov>; Hovis, Jennifer <Hovis.Jennifer@epa.gov>
Subject: Hot Tribal Sites Updates Needed - Due May 26 COB Please

Hello Superfund Regional Tribal Coordinators –

Once again we need to update the OSRTI "hot" tribal sites information sheet in anticipation of the upcoming National Tribal Operations Committee meeting on June 8 -9, 2016. The NOTC is comprised of 20 tribal leaders and EPA senior leadership (co-chaired by EPA Administrator McCarthy and typically office directors and regional administrators participate in person or by video conference).

➔To hopefully make this as painless as possible -- attached is the most recent version from November 2015 (prepared for the White House Tribal Summit) that can be used as a starting point.

➔ Per request from OLEM -- since there is a renewed focus on lead, if lead is a contaminant of concern at the “hot” site – please include any relevant information about the lead cleanup. At this time, do not add any new sites just because lead is a contaminant of concern.

➔Please provide your regional tribal “hot” site updates to both Christine Poore and me by COB Thursday, May 26, 2016.

Thank you again for your help with this!! Anne Dailey and Christine Poore (OSRTI Superfund Tribal Coordinators)

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

To: Atkins, Blake[Atkins.Blake@epa.gov]
Cc: Dailey, Anne[Dailey.Anne@epa.gov]
From: Poore, Christine
Sent: Tue 5/31/2016 6:34:42 PM
Subject: FW: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10
OSRTI Tribal Hot Sites 11-3-15-Mathy v6.docx

Hi Blake,

Anne Dailey and I are tribal coordinators in OSRTI HQ. We're in need of updates on three sites that are all within your section. Unfortunately, LaDonna Turner, who we usually coordinate through, is out of the office. Can you please ask the RPMs for the three sites below to update the attached language and provide to Anne and me as soon as possible? This is due to OLEM management by tomorrow. Sorry for the quick turnaround!

Christine

From: Dailey, Anne
Sent: Friday, May 27, 2016 11:16 AM
To: Poore, Christine <Poore.Christine@epa.gov>; OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Snyder, Jessica <Snyder.Jessica@epa.gov>
Subject: RE: Hot Tribal Sites Updates Needed - Due May 26 COB Please - ATTENTION R6, R7, R8 AND R10

Hello All –

First, a big thank you to Regions 1, 2, 5 and 9 for providing your hot site updates by the due date!

WE URGENTLY NEED THE UPDATES FOR THE FOLLOWING SITES:

R6 – Jackpile-Paguate Uranium Mine, North Railroad Plume, Tar Creek

R7 - Cherokee County

R8 - Darrow Freezeout Triangle Site, Smurfit-Stone Mill Frenchtown

R10 - Lower Duwamish Waterway, Portland Harbor, Upper Columbia River, Eastern Michaud Flats (FMC OU/Simplot OU), Gay Mine, Makah Reservation Warmhouse Beach Dump

PLEASE SEND THESE UPDATES ASAP!!! WE NEED TO SUBMIT UPDATES TODAY TO OLEM FOR PREPARATION OF BRIEFING MATERIASL FOR MATHY STANISLAUS AND THE ADMINISTRATOR.

Thank you very much for your help! Anne and Christine

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

From: Poore, Christine
Sent: Wednesday, May 25, 2016 8:39 AM
To: OLEM OSRTI SF Regional Tribal Coordinators <OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
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Thanks!

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Sent: Tuesday, May 17, 2016 10:33 AM
To: OLEM OSRTI SF Regional Tribal Coordinators
<OLEMOSRTISFRegionalTribalCoordinators@epa.gov>
Cc: Ammon, Doug <Ammon.Doug@epa.gov>; Hovis, Jennifer <Hovis.Jennifer@epa.gov>
Subject: Hot Tribal Sites Updates Needed - Due May 26 COB Please

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➔Please provide your regional tribal "hot" site updates to both Christine Poore and me by COB Thursday, May 26, 2016.

Thank you again for your help with this!! Anne Dailey and Christine Poore (OSRTI Superfund Tribal Coordinators)

Anne Dailey

US Environmental Protection Agency

Office of Superfund Remediation and

Technology Innovation

dailey.anne@epa.gov

Ph: 703-347-0373

National Topics of High Level Interest

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Region 10

Portland Harbor

Who may bring up the issue: The Yakama Tribe, the Nez Perce Tribe, the Confederated Tribes of the Siletz, Grand Rhonde, Warm Springs, and Umatilla

Background: These six Tribes may request consultation with the EPA Administrator on the upcoming remedy decision for Portland Harbor since the Administrator is signing the decision.

- The Portland Harbor Site is an enforcement lead site that spans the lower 10 miles of the Willamette River in Portland, Oregon. Although the site is not located on any of the Tribes reservations, it is within or impacts the Usual and Accustomed Areas for these tribes.

- There is a final Remedial Investigation report for the site and EPA is currently modifying the Potentially Responsible Parties Feasibility Study. EPA released the modified sections of the Feasibility Study in August, 2015.

- The site team is preparing for a review by the National Remedy Review Board and Contaminated Sediment Technical Advisory Group in November of this year.

- EPA has requested government-to-government consultation with the six Tribes to occur between November 2015 and February 2016.

Administrator's Response: EPA looks forward to consulting with the affected tribes in the near future.

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2015 White House Tribal Nations Conference & EPA's 3rd Annual Tribal Listening Session
November 6, 9:30am-11:00am EDT
EPA Green Room

<u>Purpose:</u> For EPA senior leaders to listen, gather information, and better understand tribal needs and concerns.

<u>Attendees (Roles):</u>

- **Tribal Leaders:** Meet Administrator, listen to her priorities and express thoughts and concerns to EPA senior leadership. *Note: List of attendees will be provided by end of week.*
- **Administrator's/Deputy Administrator:** Host/Facilitator; provides opening remarks; may look to AAs on specific issues. Main focus of the meeting is to listen.
- **Attending AAss:** First and foremost to listen to tribal concerns. There will be no formal speaking role planned for the AAs. *Note: Administrator and DA, may on occasion, direct questions or comments to you for clarification.*
- **Attending RAs:** First and foremost to listen to tribal concerns via phone. The lead Region will be attending on behalf of all Regions.

<u>Background:</u>
- EPA is hosting the 3rd annual Tribal Listening Sessions, as part of the WHTNC;
- The White House determines EPA's listening sessions day/time;
- Name/number of tribal leaders and representatives list of *attendees may be* known in advance (approx. 25 tribal representatives attended EPA's 2014 listening session);

<u>Next Steps:</u> EPA (OITA) develops a tracking sheet of issues raised and determines whether EPA (Region and Program) needs to provide any follow-up (i.e. more information/explanation of issue, joint response to questions, etc.)

Agenda (TBD, provided by AEIO on 11/3 or 11/24)

Information for Administrator's McCarthy's briefing book on 10/21/15 for WHTNC highlighted in yellow

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Portland Harbor [R10] 30

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Portland Harbor [R10]

Who may bring up the issue: The Yakama Tribe, the Nez Perce Tribe, the Confederated Tribes of the Siletz, Grand Rhonde, Warm Springs, and Umatilla

Issue: These six Tribes may request consultation with the EPA Administrator on the upcoming remedy decision for Portland Harbor since the Administrator is signing the decision.

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- There is a final Remedial Investigation report for the site and EPA is currently modifying the Potentially Responsible Parties Feasibility Study.
- EPA released the modified sections of the Feasibility Study in August, 2015.
- The site team is preparing for a review by the National Remedy Review Board and Contaminated Sediment Technical Advisory Group in November of this year.
- EPA has requested government-to-government consultation with the six Tribes to occur between November 2015 and February 2016.

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OSRTI "HOT" TRIBAL SITES UPDATE (draft August 5, 2015)

The following Superfund sites are included in this update:

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R10

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- **Portland Harbor (pg 21)**
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<u>Portland Harbor (Region 10)</u>

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- There is a final Remedial Investigation report for the site and EPA is currently modifying the Potentially Responsible Parties Feasibility Study.
- EPA will release the modified sections of the Feasibility Study by August 7, 2015.
- The site team is preparing for a review by the National Remedy Review Board and Contaminated Sediment Technical Advisory Group in November of this year.
- EPA has requested government-to-government consultation with the six Tribes to occur between November 2015 and February 2016.

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To: Deitz, Randy[Deitz.Randy@epa.gov]
From: Levine, Carolyn
Sent: Tue 11/4/2014 12:06:37 AM
Subject: Fwd: Portland Harbor - draft congressional update comments
Cong del PH update 11 3 2014.docx
ATT00001.htm

Fyi

Carolyn Levine
U.S. EPA
Office of Congressional Affairs
(202) 564-1859

Begin forwarded message:

From: "Cohen, Lori" <Cohen.Lori@epa.gov>
Date: November 3, 2014 at 7:03:13 PM EST
To: "Ammon, Doug" <Ammon.Doug@epa.gov>
Cc: "Yamamoto, Deb" <Yamamoto.Deb@epa.gov>, "Fonseca, Silvina" <Fonseca.Silvina@epa.gov>, "Woolford, James" <Woolford.James@epa.gov>, "Levine, Carolyn" <Levine.Carolyn@epa.gov>, "Schuster, Cindy" <Schuster.Cindy@epa.gov>
Subject: RE: Portland Harbor - draft congressional update comments

Thanks for these suggestions. I made the changes… a couple of things to note:

Jim notes questioned whether the general public would be asked for input during the NRRB process and my understanding is that we typically only have the CAG and participating PRPs, Tribes and state the opportunity to comment during NRRB. Correct?

Also, yes the Arkema work is under an Order for EE/CA but they are interested in collecting data and having us use if for RI/FS evaluation…. hence a dispute.

I think I addressed the other comments although not sure what to add about the importance of the RM 11 E work – basically shows some sampling got done.

If OSRTI is ok with this version, please let Carolyn know!

From: Ammon, Doug
Sent: Monday, November 03, 2014 2:52 PM
To: Cohen, Lori
Cc: Yamamoto, Deb; Fonseca, Silvina; Woolford, James
Subject: Portland Harbor - draft congressional update comments

Lori,

Attached are Jim's comments. Thanks.

From: EZTech_Printer [mailto:EZTek@epa.gov]
Sent: Monday, November 03, 2014 5:44 PM
To: Ammon, Doug
Subject: Portland harbor update comments on draft

Portland Harbor Superfund Site/ EPA Update for Congressional Delegation –November 3, 2014

We look forward to discussing this update with you on November 12, 2014.

Key Milestone:

EPA is on track to meet a key milestone in fall 2015, when we submit our initial cleanup proposal for the site to the National Remedy Review Board and the Contaminated Sediments Advisory Group. At that time, the Lower Willamette Group, the Citizens Advisory Group, tribes, and State and other agency partners will be able to comment on EPA's initial cleanup proposal.

Remedial Investigation/Feasibility Study:

These documents will provide the foundation for EPA's cleanup proposal. The RI/FS documents were written by the LWG but are being modified by EPA in coordination with the LWG, Tribes and agency partners to be consistent with the Superfund law, EPA regulations and EPA guidance. This will address deficiencies previously identified by EPA. The LWG filed a formal dispute with regard to EPA's calculation of background levels at the site; the dispute is under EPA review. Nevertheless, work continues and our goal is to complete the RI this calendar year. Concurrently, work is progressing to modify the Feasibility Study; EPA and the LWG are discussing options to improve the unique, collaborative process we are using to finalize this document.

State Actions:

ODEQ, as the lead agency for source control, is preparing a summary report that will be submitted to EPA in November for review of the status of source control. DEQ is planning outreach to the community on source control progress.

ODEQ sent EPA a letter outlining some concerns about the pace of the project and project management, and EPA responded. (The letters are attached). The Agencies are engaging in a series of facilitated meetings to discuss/resolve the DEQ concerns. The State has proposed taking on some sediment cleanup projects prior to EPA's cleanup decision; this could create some consistency issues that we are discussing with the State, which will be weighed against the possibility of advantages of overall project sequencing and early exposure reduction.

Outreach:

EPA continues to reach out to interested community members and participate in meetings hosted by the CAG. This past summer, EPA gave presentations during bus tours of the site sponsored by Groundwork Portland, a non-profit organization that advances environmental and social justice for disadvantaged communities. EPA collaborated with the Port of Portland on its podcast series to be launched in November that provides many perspectives on the project.

Early actions:

Arkema has filed a formal dispute under the legal agreement for early action cleanup of contaminated sediment adjacent to its facility which is under EPA review. Arkema is arguing to have additional data collected for the site and incorporated into the RI/FS. Collecting this data would likely delay the overall project schedule.

RM 11E data collection was completed in October 2014 when the final samples were collected by divers. Data is under review now which will feed into the RI/FS and remedial design.

Gasco/Siltronic work continues to focus on pre-design data collection, which included groundwater/diver collected data to pinpoint areas where upland hydraulic control can be improved and to support future design of the remedy.

Upcoming Executive Level Meetings:

On November 24, 2014, EPA Regional Administrator Dennis McLerran and HQ Director OSRTI Jim Woolford will attend the meeting to be hosted by Congressman Blumenauer and the Governor.

On December 8, 2014, EPA Regional Administrator Dennis McLerran and HQ Director OSRTI Jim Woolford will attend the meeting with the LWG Executives, and meetings with Tribal representatives and the CAG to provide project updates and continue dialogue on key issues of concern.

To: Frame, Alicia[Frame.Alicia@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Scozzafava, MichaelE[Scozzafava.MichaelE@epa.gov]; Ammon, Doug[Ammon.Doug@epa.gov]
From: Ells, Steve
Sent: Mon 11/3/2014 7:35:27 PM
Subject: FW: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI
2014_09_03 EPA Response to LWG Dispute on Background.pdf
2014-10-03 EPA Position Memo.pdf

;;;;;
Alicia, here is the Region's response for you to review.

From: Yamamoto, Deb
Sent: Monday, November 03, 2014 2:32 PM
To: Ells, Steve
Subject: FW: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI

Steve,

The first attachment is our response to the LWG's dispute over background in Section 7 of the Portland Harbor RI. The second attachment is just the cover memo To Rick Albright. FYI, the LWG has responded to our dispute statement. I will forward that next.

Deb

From: Koch, Kristine
Sent: Friday, October 03, 2014 4:29 PM
To: Bob Wyatt (rjw@nwnatural.com); Jim McKenna (jim.mckenna@verdantllc.com)
Cc: Jennifer Woronets; Yamamoto, Deb; Cora, Lori; Cohen, Lori; Sheldrake, Sean; Allen, Elizabeth
Subject: Portland Harbor - EPA response to LWG Dispute on Section 7 of the RI

Bob –

I have attached an electronic copy of the EPA's response to the LWG's Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7. A DVD containing the response and relevant reference materials has been mailed overnight to your office. Due to the size of the exhibits, EPA is only providing a copy of the transmittal letter and response in this email. I will email Jen Woronets as many of the exhibits as possible today.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

(206)553-6705
(206)553-0124 (fax)
1-800-424-4372 extension 6705 (M-F, 8-4 Pacific Time, only)

To: Woolford, James[Woolford.James@epa.gov]; Richardson, RobinH[Richardson.RobinH@epa.gov]
Cc: Ammon, Doug[Ammon.Doug@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Cooper, DavidE[Cooper.DavidE@epa.gov]; Frame, Alicia[Frame.Alicia@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Lambert, Matthew[Lambert.Matthew@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Fonseca, Silvina[Fonseca.Silvina@epa.gov]
From: Scozzafava, MichaelE
Sent: Tue 11/18/2014 2:13:11 PM
Subject: SPB Review of PDX Harbor Background Issue
Portland Harbor -- summary and detailed comments_final.docx

;;;
Jim,

As discussed, I am providing a paper that reviews the LWG's concerns about the statistical methods used to caculate background. This paper was authored primarily by Alicia Frame and with input from Steve Ells and Matt Lambert.

The paper provides a summary of our key points up front and more detail on each issue later in the document.

We are happy to discuss this analysis with you before you leave for Portland.

Mike

To: Scozzafava, MichaelE[Scozzafava.MichaelE@epa.gov]; Ells, Steve[Ells.Steve@epa.gov]; Stalcup, Dana[Stalcup.Dana@epa.gov]; Frame, Alicia[Frame.Alicia@epa.gov]
From: Woolford, James
Sent: Fri 11/21/2014 9:38:28 PM
Subject: FW: LWG Reply in Support of Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7
2014 10 14 LWG reply in support of request for dispute resolution - Ex. ....pdf
2014 10 14 LWG reply in support of request for dispute resolution.pdf

;;;;;;;;;;;;
Don't know if you all have the subsequent letter from the LWG

Jim Woolford, Director

Office of Superfund Remediation and Technology Innovation

Office of Solid Waste and Emergency Response

US Environmental Protection Agency

1200 Penn. Ave., NW

Washington, DC 20460

(Mail Code 5201-P)

Phone: (703) 603 8960– Main Office Line

Physically located at:

Room 5622

One Potomac Yard (South)
2777 S. Crystal Dr.
Arlington, VA 22202

From: Jennifer Woronets [mailto:jworonets@anchorqea.com]
Sent: Tuesday, October 14, 2014 7:11 PM
To: Cohen, Lori; Yamamoto, Deb; Sheldrake, Sean; Woolford, James; Nussbaum, Barry
Cc: Jennifer Woronets; Matt Stock; Albright, Rick; Cora, Lori; Albright, Rick; Koch, Kristine; Matt Stock; erin.madden@gmail.com; Albright, Rick; Albright, Rick; ryan sudbury; Cora, Lori;

Koch, Kristine; Michael.karnosh@grandronde.org; audiehuber@ctuir.com; JD Williams; cunninghame@gorge.net; Tom Gainer; Bob Wyatt; Jennifer Kassakian; Robert.Neely@noaa.gov; Holly Partridge; callie@ridolfi.com; Patty Dost; MCCLINCY Matt; Jim McKenna (jim.mckenna@verdantllc.com); Gail Fricano; rose@yakamafish-nsn.gov; Rachel DelVecchio; Julie Weis; Personal Privacy / Ex. 6
Subject: FW: LWG Reply in Support of Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7

Ms. Cohen, Ms. Yamamoto, Mr. Sheldrake, Mr. Woolford, Mr. Nussbaum,

Please see below and attached LWG reply in support of the request for dispute resolution of EPA's notice of decisions on background regarding the RI Section 7.

Thank you,

Jen Woronets ☺

Anchor QEA, LLC

jworonets@anchorqea.com

421 SW Sixth Avenue, Suite 750

Portland, OR 97204

503-972-5014

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From: Matt Stock [mailto:mstock@jzplaw.com]
Sent: Tuesday, October 14, 2014 4:02 PM
To: albright.rick@epa.gov; Albright.Rick@epamail.epa.gov; Cora.Lori@epa.gov; Koch.Kristine@epa.gov
Cc: Jennifer Woronets
Subject: LWG Reply in Support of Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7

Mr. Albright, Ms. Cora, and Ms. Koch,

I have attached the Lower Willamette Group's Reply in Support of Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7 for your review and consideration. If you would like a hard copy of the reply, or have any questions, please feel free to contact me.

Regards,

Matt

Matthew J. Stock
Joyce Ziker Parkinson, PLLC
1601 Fifth Avenue, Suite 2040
Seattle, WA 98101
Office: (206) 957-5960
Direct: (206) 957-5955
Fax: (206) 957-5961

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Consider the environment before printing.

To: Fleming, Sheila[fleming.sheila@epa.gov]
From: Sheila Fleming
Sent: Sat 6/4/2016 10:48:09 PM
Subject: Tables for J1.xlsx
Tables for J1.xlsx

Table J1-1
Residual Risk - RAO 1
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Units	Beach Sediment R-PRG (10^{-6})	Beach Sediment R-PRG (HQ=1)	Beach Sediment F-PRG	Sediment R-PRG (10^{-6})	Sediment R-PRG (HQ=1)	Sediment F-PRG	Residual Risk - Beach Risk	Residual Risk - Beach HI	Residual Risk - Sediment Risk	Residual Risk - Sediment HI
Arsenic	mg/kg	0.4	37	3	1	435	3	8/E-06	0.08	3.E-06	0.007
PCBs	µg/kg				370	14,760	370			1.E-06	0.03
cPAHs (BaP Eq)	µg/kg	12	NA	12	106	NA	106	1.E-06		1.E-06	
Dioxins/Furans (2,3,7,8-TCDD e	µg/kg				0.01	1.0	0.01			1.E-06	0.01
							Total	**9/E-06**	**0.08**	**6.E-06**	**0.04**

Table J1-2
Residual Risk Estimates - RAO 2
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Tissue PRG - 142 g/day			Tissue PRG - 49 g/day			Calculated Tissue Conc from FWM (µg/kg)	Residual Risk (Site-wide)			Residual Risk (RM/SDU)		
	Risk (10^{-6})	Child	Infant	Risk (10^{-6})	Child	Infant		Risk	Hi-Child	HI-Infant	Risk	Hi-Child	HI-Infant
Aldrin	0.06	7.9		0.2	23		0.06	1E-06	0.008		4E-07	0.003	
Chlordanes	3	131		8.3	380		3.0	1E-08	0.02		4E-07	0.008	
DDx	3	131	89	8.6	380	258	3.0	1E-06	0.02	0.03	4E-07	0.008	0.01
Dieldrin	0.06	13.1		0.2	38		0.063	1E-06	0.005		3E-07	0.002	
PCBs	0.5	5.2	0.25	1.5	15	0.7	23	5E-05	4	93	2E-05	1.536	32
cPAHs (BaP Eq)	7.1						7.1	1E-06					
1,2,3,4,7,8-HxCDF	0.00008	0.0	0.00	0.0002	0.005	0.0002	0.0002	2E-06	0.1	3	8E-07	0.035	1
1,2,3,7,8-PeCDD	0.000008	0.0	0.00	0.00002	0.0005	0.00002	0.0001	1E-05	0.5	16	4E-06	0.172	5
2,3,4,7,8-PeCDF	0.00003	0.0	0.00	0.00007	0.0018	0.00006	0.00003	1E-06	0.05	2	4E-07	0.019	0.6
2,3,7,8-TCDD	0.000008	0.0	0.00	0.00002	0.0005	0.00002	0.0001	1E-05	1	17	4E-06	0.188	6
2,3,7,8-TCDF	0.00008	0.0	0.00	0.0002	0.005	0.0002	0.00006	7E-07	0.03	1	3E-07	0.011	0.3
							Total	**8E-05**	**6**	**132**	**3E-05**	**2**	**45**

Table J1-3
Residual HQs - RAO 6
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Units	R-PRG (HQ=1)	F-PRG	Residual HQ
BEHP	µg/kg	135	135	1
DDE	µg/kg	226	226	1
DDx	µg/kg	760	760	1
PCBs	µg/kg	36	36	1
1,2,3,4,7,8-HxCDF	µg/kg	0.03	0.03	1
1,2,3,7,8-PeCDD	µg/kg	0.001	0.001	1
2,3,4,7,8-PeCDF	µg/kg	0.004	0.004	1
2,3,7,8-TCDD	µg/kg	0.0008	0.0008	1
2,3,7,8-TCDF	µg/kg	0.004	0.004	1

To: Grandinetti, Cami[Grandinetti.Cami@epa.gov]; Fleming, Sheila[fleming.sheila@epa.gov]
From: MacIntyre, Mark
Sent: Wed 6/1/2016 2:06:55 PM
Subject: Fwd: Draft Portland Harbor Proposed Plan
PH Proposed Plan Jim's Overview 5-27-16 sf comments.docx
ATT00001.htm

I guess this is also the "Community Summary"....

Sent from my iPhone

Begin forwarded message:

From: "Conley, Alanna" <conley.alanna@epa.gov>
Date: June 1, 2016 at 7:00:09 AM PDT
To: "MacIntyre, Mark" <Macintyre.Mark@epa.gov>
Subject: FW: Draft Portland Harbor Proposed Plan

FYI

From: Christopher, Anne
Sent: Friday, May 27, 2016 8:50 PM
To: Woolford, James <Woolford.James@epa.gov>; Grandinetti, Cami <Grandinetti.Cami@epa.gov>; Zhen, Davis <Zhen.Davis@epa.gov>; Fonseca, Silvina <Fonseca.Silvina@epa.gov>; Koch, Kristine <Koch.Kristine@epa.gov>; Allen, Elizabeth <allen.elizabeth@epa.gov>; Legare, Amy <Legare.Amy@epa.gov>; Fleming, Sheila <fleming.sheila@epa.gov>; Cora, Lori <Cora.Lori@epa.gov>; Ells, Steve <Ells.Steve@epa.gov>; Conley, Alanna <conley.alanna@epa.gov>; Knudsen, Laura <Knudsen.Laura@epa.gov>
Subject: RE: Draft Portland Harbor Proposed Plan

Here is an updated version of Jim's Overview of the PP. This is supposed to be the shorter "fact sheet" (it is 3.5 pages). We included the Rationale for the Preferred Alternative, as Dennis requested.

Please send me any edits/comments.

Thanks,

Annie

To: Fleming, Sheila[fleming.sheila@epa.gov]
From: Zhen, Davis
Sent: Wed 3/2/2016 9:03:29 PM
Subject: Fwd: DId you review the MOST RECENT admin briefing paper?? Attached and I sent it out last night - please look at it.
2016 3-10 Administrator Briefing Memo - Portland Harbor DRAFT rev as of 3-1-16 sje_SF_AC _al.docx
ATT00001.htm

Thanks,

Sent from iPhone
****
Davis Zhen
Environmental Cleanup Unit 2
Office of Environmental Cleanup
1200 Sixth Avenue Suite 900
M/S ECL – 122, Seattle, WA 98101
Tel: (206) 553-7660
Cell: (206) 437-5826
****

Begin forwarded message:

From: "Robinson, Deborah" <Robinson.Deborah@epa.gov>
Date: March 2, 2016 at 10:28:25 AM PST
To: "Grandinetti, Cami" <Grandinetti.Cami@epa.gov>
Cc: "Zhen, Davis" <Zhen.Davis@epa.gov>
Subject: DId you review the MOST RECENT admin briefing paper?? Attached and I sent it out last night - please look at it.

Thanks,

Debbie

====================================
From the Desk of:
Debbie Robinson

Tel: 206-553-4961
robinson.deborah@epa.gov

US EPA Region 10, M/S ECL 122, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101

DELIBERATIVE

DRAFT

U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington D.C.

PORTLAND HARBOR UPDATE

DATE: March 10, 2016
LOCATION: Telephone
MEETING TIME: 4:00 – 5:00 pm EST

I. REQUESTING OFFICE: EPA Region 10, OLEM

II. TIMELINE

- **November 18-19, 2015:** EPA's National Remedy Review Board and Contaminated Sediments Technical Advisory Group (NRRB/CSTAG) Meeting
- **December 31, 2015:** NRRB/CSTAG Issues Recommendations
- **January 21, 2016**: Region Responds to NRRB/CSTAG Recommendations
- **January and February 2016:** Five Government to Government Tribal Consultations (the sixth Tribe had to postpone, now scheduled for March 22, 2016)
- **February 8, 2016:** Completed Final Remedial Investigation (RI) Report
- **February and March 2016:** Extensive public outreach
- **April 2016:** Issue Feasibility Study (FS) and Proposed Plan (PP). LWG has 14 days from issuance of PP to dispute the FS.
- **April – June 2016:** 60-Day Public Comment Period, including a second round of tribal consultations
- **December 31, 2016:** Issue Record of Decision (ROD), including Responsiveness Summary

III. PURPOSE

Update the Administrator on the status of remedy selection and the preferred alternative and identify any concerns early so there is time to address them prior to publication of the PP.

Unlike other Superfund sites, the EPA Administrator will sign the Portland Harbor Record of Decision. The focus of the briefing is to update the Administrator on the status of remedy selection, review the preferred alternative we plan to propose in the PP, and update the Administrator on feedback received from EPA's NRRB and CSTAG (the Boards) and various parties, including Tribes, businesses, local and national elected officials, the public, and the State.

IV. BACKGROUND AND HISTORY

- The Portland Harbor Site was listed on the National Priorities List in December 2000. There are high levels of PCBs, dioxins/furans, PAHs, pesticides and other contaminants that present risk to human health and the environment that will require cleanup in the Willamette River.
- Contaminant levels and environmental conditions vary throughout the site. There are several areas that are significantly contaminated and will need active cleanup, including dredging and capping. Enhanced natural recovery/in-situ treatment and monitored natural recovery may be the appropriate action in other areas.
- In 2001, ten potentially responsible parties signed an AOC to conduct the Remedial Investigation/Feasibility Study (RI/FS). The ten parties are referred to as The Lower Willamette Group (LWG).
- After an extensive PRP search, EPA has identified more than 150 PRPs.
- At the direction of EPA, the LWG completed the final RI Report on February 8, 2016.
- The FS will be completed by EPA and issued at the same time as the PP, expected to be issued in April 2016.

V. KEY ISSUES

Current Status: The EPA made a determination that it would be more efficient to complete the FS rather than direct the LWG to do so. The FS will be issued at the same time as the PP.

- EPA is considering all past comments received from the LWG, as well as the State, Tribes, natural resource agencies, Community Advisory Group, and the Boards in completing the FS.
- EPA sent a letter to the LWG on January 4, 2016 to inform the LWG of EPA's decision to complete the FS.
- The LWG filed an informal dispute disagreeing that EPA could take over the FS and on their inability to file a dispute on the completed FS. The LWG also requested that EPA employ Alternative Dispute Resolution (ADR) to resolve the dispute.
- EPA and the LWG settled this dispute on February 4, 2016, with an agreement that:
    - Both parties mutually agreed EPA could finalize the FS
    - The LWG would withdraw this dispute and its subsequent request for ADR.
    - The LWG would be allowed to dispute the final FS, once issued. Resolution of the dispute will occur during the public comment process. However, to maintain the integrity of the public comment process, EPA will not have separate meetings with the parties on the dispute. EPA's response and resolution to the dispute will be reflected primarily in the responsiveness summary, which is part of the ROD.
    - EPA will not require the LWG to reimburse EPA's costs under the AOC in finalizing the FS. This includes \$2.9M incurred in FY15 and any costs for finalizing the FS during FY16. EPA reserved its rights to seek all costs in future negotiations or litigation.

Current Status: Since the issuance of the draft FS in August 2015, EPA developed an optimized alternative which will be presented as the Preferred Alternative in the PP. The optimized alternative was reviewed by the Boards, and will be evaluated in the FS, along with the other alternatives.

- The alternatives originally evaluated in the draft FS individually did not reduce risk consistently throughout the site. The risk reductions were greater in some areas and less in others. Using Alternative E as a baseline, an optimized alternative was developed to meet specific objectives and achieve more uniform risk reduction throughout the site. In some areas those objectives are met with Alternative E, in others they are met with alternatives that rely more on MNR and in some areas with alternatives that rely less on MNR.
- The objectives of the optimized alternative include:
    - Address majority of Principal Threat Waste
    - Meet Preliminary Remediation Goals for ecological receptors as early as possible
    - Minimize Institutional Controls for people eating contaminated fish and shellfish
    - Minimize recontamination from riverbanks
    - Increase fish consumption rates to at least the rates achieved by Alternative E, on a site-wide basis
    - Minimize river use restrictions (use of caps)
    - Achieve acceptable risk ranges for most people using the river at the time construction of the remedy is completed

The optimized alternative includes active remediation (dredging, capping and treatment) to reduce risk to a certain level at the time of construction, followed by monitored natural recovery to allow the river to reach cleanup levels, post construction.

Current Status: EPA is conducting an extensive outreach campaign to educate the public and the community prior to release of the FS and PP. EPA is also coordinating with the City of Portland and the State on this outreach effort.

- In addition to our ongoing regular interactions with key stakeholder groups, EPA is reaching out to the broad community as well as a wide range of interest groups, including:
    - Groups representing vulnerable populations
    - Students ranging from elementary school to college classes
    - Youth organizations
    - Local and national non-profit groups
    - Neighborhood associations
    - City, County and State elected officials
    - Business associations
    - The media
- EPA's communication goal prior to issuing the PP is to assure that affected community members and the public are prepared to provide EPA meaningful comments and fully participate in the public process once the PP is issued. EPA is

communicating background information, associated site risks, basis for EPA action, EPA's technical approach and technologies under consideration, remedy selection schedule and how community members can participate.

- EPA plans to meet with the congressional delegation, LWG Executives, MOU Partners (six Federally Recognized Tribes and Natural Resource Trustees) and Community Partners on March 30 and 31, just prior to issuing the PP.

Current Status: Various groups have conveyed important concerns to EPA

- Implementability of the remedy: In the interest of more quickly signing Consent Decrees and starting Remedial Design, and in the interest of parties having more certainty that they will be relieved of liability in certain locations in the river, EPA has been asked by the State and some of the other PRPs to consider designating some of the thirteen EPA-defined Sediment Decision Units as Operable Units in the ROD. EPA has been evaluating the site holistically, including developing alternatives that address the whole site, rather than specific areas, and therefore has not divided the site into OUs. We are in active conversations to understand the underlying interests and attempt to resolve both concerns. We can, and most likely will, phase the remedial design and implementation of the remedial action, which will help to address some of these concerns.

Current Status: Various groups have conveyed important concerns to the EPA

- Implementability of the remedy: EPA has been asked by the State and a couple PRPs to consider designating Operable Units within the site for the main purpose of dividing the cleanup responsibility into smaller areas. The State and PRPs believe dividing the site into Operable Units will leadto Consent Decrees being signed sooner and starting Remedial Design., EPA has been evaluating the site holistically, including developing alternatives that address the whole site, rather than specific areas, and therefore has not divided the site into OUs. The information on fate and transport also supports that the harm from the releases of hazardous substances to the river is not divisible in large measure and the PRPs are jointly and severally liable to cleanup the entire site. We believe that post-ROD negotiations can lead to agreements for different groups of PRPs performing the cleanup at different areas and there is no need to divide the site into OUs in the Proposed Plan and ROD. We are in active conversations to understand the underlying interests and attempt to provide sufficient information to the State and PRPs about possibilities in post-ROD discussions. We can, and most likely will, phase the remedial design and implementation of the remedial action, which will help to address some of these concerns.

- Protectiveness of the remedy and health of the Columbia River. Some Tribes and the Community Advisory Group are advocating for a remedy that includes removal of the maximum amount of contamination in the river. In order to consider this remedy, we are adding another alternative in the FS that includes active cleanup (dredging and capping) to achieve the cleanup levels at the end of construction, i.e, not rely on MNR to further reduce risks. In addition, in response to a comment from the Boards, we are evaluating the contaminant loading from the site to the Columbia River, and the reduction in contaminant loading to the Columbia expected from the various cleanup alternatives.

- The Tribes are following EPA's work on Portland Harbor very closely and asking detailed technical questions. We plan to conduct another round of consultations with the Tribes during the public comment period. Yakama Nation has indicated they may seek to consult directly with the EPA Administrator. Some Tribes are seeking the highest level of cleanup. Yakama Nation presented EPA with a Tribal Council Resolution demanding that EPA mandate a cleanup within the ROD that is "protective of all Yakama Nation members from the toxics from this site and provides for the safe consumption of fish and traditional use of our Treaty Reserved Resources." The Superfund cleanup will meet CERCLA and NCP requirements, which will reduce risk but will not return the river to pre-Treaty conditions.

- Cost: Individual PRPs have conveyed concerns about their ability to afford the cleanup under the joint and several liability provision. Local elected officials have raised concerns about the trade-offs of spending billions of dollars to clean up the Willamette River versus other important city projects and programs. PRPs have also expressed concern about the uncertainty of the cost estimates contained in the FS. In response, EPA is carefully reviewing assumptions in order to develop the most accurate cost estimates possible to include in the FS. Generally and consistent with EPA policy and guidance, cost estimates developed for FSs and RODs have a margin of error of +50 to -30 percent of the actual costs. The cost estimates are then better defined in the remedial design stage.

To: Fleming, Sheila[fleming.sheila@epa.gov]
From: Fleming, Sheila
Sent: Sat 1/23/2016 4:50:38 AM
Subject: Fwd: Portland Harbor Superfund Site--Request to Resolve Issues re Jan 4 Letter

Sheila

Begin forwarded message:

From: "Pirzadeh, Michelle" <Pirzadeh.Michelle@epa.gov>
Date: January 20, 2016 at 4:32:28 PM EST
To: "Fleming, Sheila" <fleming.sheila@epa.gov>
Subject: FW: Portland Harbor Superfund Site--Request to Resolve Issues re Jan 4 Letter

FYI

Michelle L. Pirzadeh

Deputy Regional Administrator

U.S. Environmental Protection Agency, Region 10

Office: (206) 553-1234

Cell: (206) 499-1927

Fax: (206) 553-1809

From: Hamilton, Jessica [mailto:Jessica.Hamilton@portofportland.com]
Sent: Tuesday, January 19, 2016 3:18 PM
To: McLerran, Dennis <mclerran.dennis@epa.gov>
Cc: Stern, Allyn <Stern.Allyn@epa.gov>; Pirzadeh, Michelle <Pirzadeh.Michelle@epa.gov>; Grandinetti, Cami <Grandinetti.Cami@epa.gov>; Woolford, James <Woolford.James@epa.gov>; Mackey, Cyndy <Mackey.Cyndy@epa.gov>; Tom Imeson <tom.imeson@nwnatural.com>; Decker, Megan <Megan.Decker@portofportland.com>; Patricia M. Dost (pdost@pearllegalgroup.com) (pdost@pearllegalgroup.com) <pdost@pearllegalgroup.com>; MardiLyn.Saathoff@nwnatural.com
Subject: RE: Portland Harbor Superfund Site--Request to Resolve Issues re Jan 4 Letter

Thank you for making time this morning to revisit a potential path forward from EPA's January 4 letter. We understand your interests surrounding EPA's schedule and your desire to complete the FS yourself, and we also understand you have firm views of the Consent Order and our previous agreements. It appears that, at this time, those views prevent you from considering the LWG's proposal for a path forward that allows for dispute resolution of the final FS with minimum impact to EPA's schedule. As you know from our phone conversation today, we offered to have EPA complete the FS (assuming a retraction of the January 4 letter) so long as EPA recognizes our right to dispute the content of the Final FS. We would agree to a deferred dispute resolution process on the Final FS to run concurrently with the Public Comment period so as to minimize resource disruptions that could lead to delay. As a result of our inability to reach agreement, the LWG will be filing its dispute today. We remain open to discussion of an alternative path that accomplishes both parties' needs during the 14-day informal negotiation period and are hopeful that we can reach an acceptable resolution during that time.

As we discussed, Patty Dost is the point person for legal issues, and I will serve as point person for Senior Managers. Patty's email is pdost@pearllegalgroup.com.

Again, thank you for your time this morning and for putting together the call on such short notice.

Jessica and Tom

Jessica Hamilton

Port of Portland

Direct: 503-415-6033

Jessica.Hamilton@portofportland.com

The information contained in this e-mail message may be privileged, confidential and protected from disclosure. If you are not the intended recipient, any dissemination, distribution or copying is strictly prohibited. If you think that you have received this e-mail in error, please e-mail the sender at Jessica.Hamilton@portofportland.com

From: McLerran, Dennis [mailto:mclerran.dennis@epa.gov]
Sent: Monday, January 18, 2016 8:36 PM
To: Hamilton, Jessica
Cc: Stern, Allyn; Pirzadeh, Michelle; Grandinetti, Cami; Woolford, James; Mackey, Cyndy
Subject: Re: Portland Harbor Superfund Site--Request to Resolve Issues re Jan 4 Letter

Thanks Jessica.

Dennis McLerran

Sent from my EPA iPhone

On Jan 18, 2016, at 8:35 PM, Hamilton, Jessica <Jessica.Hamilton@portofportland.com> wrote:

We can use this number tomorrow. I will dial in as host.

Toll Free:

Host Code:

Participant Code:

Personal Privacy / Ex. 6

Talk to you tomorrow. Jessica

Sent from my iPhone

Sent from my iPhone

On Jan 18, 2016, at 7:16 PM, McLerran, Dennis <mclerran.dennis@epa.gov> wrote:

Jessica:

If you could set up a call in number that would be great. I look forward to talking tomorrow.

Dennis McLerran

Regional Administrator

EPA Region 10

From: Hamilton, Jessica <Jessica.Hamilton@portofportland.com>
Sent: Monday, January 18, 2016 11:13 AM
To: McLerran, Dennis
Cc: Grandinetti, Cami; Tom Imeson; Robinhold, Curtis; Magorrian, Matthew; Pirzadeh, Michelle; Woolford, James; Stern, Allyn; Mackey, Cyndy; Cora, Lori
Subject: Re: Portland Harbor Superfund Site--Request to Resolve Issues re Jan 4 Letter

Confirmed for 9am. Tom and I will be making the call from separate locations so please let me know if you need me to supply a call-in number. Thanks. Jessica

Sent from my iPhone

On Jan 17, 2016, at 3:53 PM, McLerran, Dennis <mclerran.dennis@epa.gov> wrote:

> Jessica:
>
> Cami and I can be available to talk at 9 AM Tuesday. Please call 206 553-1234 and we will take the call from my office. We would like to work on a way to keep the schedule while making sure you have the opportunity to build your record. At this point our attorneys do not believe the AOC provides for a dispute of the final FS content but we are willing to hear why you believe otherwise.
>
> Dennis McLerran

Regional Administrator

EPA Region 10

Sent from my EPA iPhone

On Jan 16, 2016, at 10:38 AM, Hamilton, Jessica <Jessica.Hamilton@portofportland.com> wrote:

Dennis and Cami:

The LWG is facing a dispute deadline of Tuesday, January 19, and we intend to file our dispute, unless we can work something out with EPA that protects our ability to recover costs and also allows us to maintain our right to dispute the final FS, which is clearly contemplated and agreed to by the agency under the FS Process Agreement, which ties that right to the AOC, as well as a plain reading of the AOC itself.

The LWG, as we expressed when we first received the letter, believes that there is an acceptable solution out there, for both parties, to achieve EPA's goal of completing the FS and staying on schedule, well short of the approach outlined in your January 4 letter.

We would like to explore again with you whether we can reach agreement without initiating dispute. **We propose we discuss via conference call on Tuesday morning. Tom and I can both be available at 7:30 am, 9 am, or noon for a call.** Please let me know if you would like to try to work this out with us.

In anticipation of being able to come to a conceptual agreement, I will also ask for authority from the LWG to accept a short extension of the deadline to dispute in the event that EPA would like more time to memorialize the terms. Just to be clear, we do not need an extension in order to file our dispute; rather any extension would solely be accepted to allow for the LWG and EPA to be able to finalize an agreement without LWG having to preemptively file a dispute to avoid waiving any rights.

We remain very hopeful and optimistic that we can work something out that allows EPA to stay on schedule and to complete the FS, but also accommodates the needs of the LWG to protect our legal rights.

We look forward to hearing from you about whether you would like to discuss on Tuesday, and if so, what time will work.

Thank you,

Jessica and Tom

Jessica Hamilton

General Manager, Harbor Environmental

Port of Portland

7200 NE Airport Way

Portland, OR 97218

PO Box 3529

Portland, OR 97208

Cell: 503-740-0819

Direct: 503-415-6033

Fax: 503-548-5546

Jessica.Hamilton@portofportland.com

The information contained in this e-mail message may be privileged, confidential and protected from disclosure. If you are not the intended recipient, any

dissemination, distribution or copying is strictly prohibited. If you think that you have received this e-mail in error, please e-mail the sender at Jessica.Hamilton@portofportland.com

To: Bill Ross[bross@rossstrategic.com]; Fleming, Sheila[fleming.sheila@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Grandinetti, Cami[Grandinetti.Cami@epa.gov]
Cc: Robinson, Deborah[Robinson.Deborah@epa.gov]
From: PARRETT Kevin
Sent: Tue 10/13/2015 1:38:38 AM
Subject: RE: draft agendas for technical teams and management teams meeting on 10/`14/15 re Portland Harbor cleanup.

Looks good.

From: Bill Ross [mailto:bross@rossstrategic.com]
Sent: Monday, October 12, 2015 5:04 PM
To: Fleming.sheila@epa.gov; Koch.kristine@epa.gov; PARRETT Kevin; Cami Grandinetti (grandinetti.cami@epa.gov)
Cc: Deborah Robinson (robinson.deborah@epa.gov)
Subject: RE: draft agendas for technical teams and management teams meeting on 10/`14/15 re Portland Harbor cleanup.

Spelling Sheila's name right this time....(duh...) Reply using this one. Thanks

---

From: Bill Ross
Sent: Monday, October 12, 2015 5:01 PM
To: 'Fleming.shelia@epa.gov' <Fleming.shelia@epa.gov>; 'Koch.kristine@epa.gov' <Koch.kristine@epa.gov>; Parrett.Kevin@deq.state.or.us; Cami Grandinetti (grandinetti.cami@epa.gov) <grandinetti.cami@epa.gov>
Cc: Deborah Robinson (robinson.deborah@epa.gov) <robinson.deborah@epa.gov>
Subject: draft agendas for technical teams and management teams meeting on 10/`14/15 re Portland Harbor cleanup.

Hi all,

Here are the draft agenda items for the two Wednesday meetings. These are the result of the conversations that have occurred over the past 10 days or so based upon what EPA is going to direct the NRRB to consider, what DEQ is preparing in it FS comments and written submission to the NRRB and how the schedule is evolving to connect with congress, the LWG, the CAG, the Tribes, etc.

Shelia/Cami, let me know if you want to talk to me about any of this and/or if you think we should all get on the phone together to confirm expectations, presentations and outcomes.

Technical teams agenda:

1.Latest direction on what EPA is technically requesting that the NRRB focus on as the potential preferred remedy. (Kristine Koch)

2. DEQ Q&A on EPA's direction and Overview of State of Oregon's likely written response to NRRB (Kevin Parrett):

Cover letter outlining Oregon's values that comprise a successful cleanup

Recommendations of areas where additional analysis, adjustment of assumptions and/or alternative cleanup strategies might help produce a cost-effective cleanup consistent with Oregon's values for a successful cleanup.

3. Description of NRRB process at the November meeting. (Cami/Shelia)

4. Review of the schedule of key meetings/activities (Cami)

5. Identification of potential topics for the Dennis/Dick/Jim briefing on 10/19/15 (All)

Managers meeting:

1. Continued refinement of EPA direction to NRRB and Oregon's written response to NRRB, if needed.

2. Discussion of what Congressional engagement should look like when (and with Members or just staff) over next two months or so:

a. 'Roll-up the sleeves' (and/or pre-written submission to NRRB)

b. Post written submission to NNRB and prior to November NNRB meeting

c. Post November NRRB meeting and prior to posting of NRRB findings

d. After posting of NRRB findings

3. Development of agenda for Dennis/Dick/Jim briefing on 10/19/15

4. Other topics as requested

Let me know what you think and I will get the final agendas out tomorrow to the attendees that Debbie has sent the meeting invite to.

Thanks, Bill

Bill Ross | Principal
Ross Strategic | 1218 3rd Ave, Suite 1207, Seattle WA 98101
Desk: 206.792.4040 | Cell: 206.669.8376

bross@rossstrategic.com | http://rossstrategic.com

To: Fleming, Sheila[fleming.sheila@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Parrett.Kevin@deq.state.or.us[Parrett.Kevin@deq.state.or.us]; Grandinetti, Cami[Grandinetti.Cami@epa.gov]
Cc: Robinson, Deborah[Robinson.Deborah@epa.gov]
From: Bill Ross
Sent: Tue 10/13/2015 12:03:31 AM
Subject: RE: draft agendas for technical teams and management teams meeting on 10/`14/15 re Portland Harbor cleanup.

Spelling Sheila's name right this time....(duh...) Reply using this one. Thanks

---

From: Bill Ross
Sent: Monday, October 12, 2015 5:01 PM
To: 'Fleming.shelia@epa.gov' <Fleming.shelia@epa.gov>; 'Koch.kristine@epa.gov' <Koch.kristine@epa.gov>; Parrett.Kevin@deq.state.or.us; Cami Grandinetti (grandinetti.cami@epa.gov) <grandinetti.cami@epa.gov>
Cc: Deborah Robinson (robinson.deborah@epa.gov) <robinson.deborah@epa.gov>
Subject: draft agendas for technical teams and management teams meeting on 10/`14/15 re Portland Harbor cleanup.

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Shelia/Cami, let me know if you want to talk to me about any of this and/or if you think we should all get on the phone together to confirm expectations, presentations and outcomes.

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4. Review of the schedule of key meetings/activities (Cami)
5. Identification of potential topics for the Dennis/Dick/Jim briefing on 10/19/15 (All)

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1. Continued refinement of EPA direction to NRRB and Oregon's written response to NRRB, if needed.
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a. 'Roll-up the sleeves' (and/or pre-written submission to NRRB)
b. Post written submission to NNRB and prior to November NNRB meeting
c. Post November NRRB meeting and prior to posting of NRRB findings
d. After posting of NRRB findings

3. Development of agenda for Dennis/Dick/Jim briefing on 10/19/15
4. Other topics as requested

Let me know what you think and I will get the final agendas out tomorrow to the attendees that Debbie has sent the meeting invite to.

Thanks, Bill

Bill Ross | Principal
Ross Strategic | 1218 3rd Ave, Suite 1207, Seattle WA 98101
Desk: 206.792.4040 | Cell: 206.669.8376
bross@rossstrategic.com | http://rossstrategic.com

To: Fleming, Sheila[fleming.sheila@epa.gov]
From: U.S. Environmental Protection Agency
Sent: Wed 8/5/2015 6:09:54 AM
Subject: Portland Harbor Superfund Site Update

Portland Harbor Update

EPA will soon share the final two sections of its draft Portland Harbor Feasibility Study (FS) with the groups that have been working closely with the EPA on the development of the cleanup plan for Portland Harbor: the Oregon Department of Environmental Quality, six tribes, the Natural Resource Trustees, the Community Advisory Group and the Lower Willamette Group.

Sections 3 and 4 of the Feasibility Study detail the toxins that need to be addressed, the sites where those toxins pose the greatest risks, the five alternatives for addressing the risks at each site, and the costs of the alternatives.

EPA expects to release a proposed cleanup plan for public review and comment in the spring of 2016, but there are several internal review steps to complete before releasing the Proposed Plan.

First, EPA will present a *Conceptual Remedy* to the **National Remedy Review Board** and the **Contaminated Sediment Technical Advisory Group** for internal review prior to issuing the Proposed Plan. This step is required for sites like Portland Harbor where cleanup will cost more than $50 million. The NRRB and CSTAG reviews ensure national consistency with the law, EPA policies and guidance, and take into consideration past practice at sites of similar magnitude.

The Lower Willamette Group, Oregon DEQ, the tribes, trustees and the Portland Harbor Community Advisory Group can provide input to the NRRB and CSTAG on the *Conceptual Remedy*, which the EPA will share on **September 18**.

The NRRB and CSTAG are then scheduled to review the *Conceptual Remedy* and comments from the parties on **November 18 and 19** in Portland, Oregon.

At that point, the EPA site team will use the recommendations from the NRRB and CSTAG in developing the *Proposed Plan*. The Proposed Plan will go through the full Superfund public comment process once it is release in the **spring of 2016**.

What do Sections 3 and 4 of the Feasibility Study cover?

Section 3 of the Feasibility Study focuses on the pollution that must be addressed, where that pollution is and the alternatives for cleaning it up.

Specifically Section 3

- Addresses reducing the risks from sediments contaminated with more than 40 toxic chemicals and compounds including: polychlorinated biphenyls (PCBs), total polycylic aromatic hydrocarbons (PAHs), dioxins/furans, and the pesticide DDT and its by-products, DDE and DDD.

- Identifies and addresses Principal Threat Waste (PTW), including pure chemical product seeping from the sediments within the site, as well as highly contaminated sediments;
- Addresses contaminated groundwater seeping into the river; and
- Presents five different cleanup alternatives the EPA is evaluating.

EPA's evaluation of cleanup alternatives is focused on reducing the risk to people over the long term through achievable cleanup goals. When developing the final alternatives, EPA will consider the environmental conditions of the river, and the current and potential future uses (industrial, recreational, etc.) of a particular site. To the degree possible, EPA will also seek to limit restrictions on sites. For example:

- Appropriate beach material will be placed in sediment cleanup locations that serve as public access points for recreation or wildlife habitat.
- EPA will consider limiting the use of caps in locations where commercial and shipping activities occur.
- EPA will also consider future navigation and maintenance dredging when determining the appropriate cleanup technology.

Section 4 of the Feasibility Study will include cost estimates of the cleanup alternatives, as well as an evaluation against seven of the nine criteria required under the Comprehensive Environmental Response, Compensation and Liability Act, also known as the Superfund law. Two of the criteria – state and tribal acceptance and community acceptance will be evaluated during EPA's review of the public comments.

This long process isn't over yet, but the end is in sight! All the parties are working toward the same goal, which is a cleaner, healthier Willamette River.

For additional information, visit the EPA Portland Harbor webpage, or contact Alanna Conley, EPA Community Involvement Coordinator at conley.alanna@epa.gov or 503-326-6831.

Thank you!

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To: Shephard, Burt[Shephard.Burt@epa.gov]
Cc: Sheldrake, Sean[sheldrake.sean@epa.gov]; Fleming, Sheila[fleming.sheila@epa.gov]
From: Koch, Kristine
Sent: Tue 11/4/2014 9:34:22 PM
Subject: RE: Manganese memo

Thanks, I'll pass this along.

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

U. S. Environmental Protection Agency
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(206)553-6705
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From: Shephard, Burt
Sent: Tuesday, November 04, 2014 1:13 PM
To: Koch, Kristine
Cc: Sheldrake, Sean; Fleming, Sheila
Subject: RE: Manganese memo

Deliberative Process / Ex. 5

Best regards,

Burt Shephard

Risk Evaluation Unit
Office of Environmental Assessment (OEA-095)
U.S. Environmental Protection Agency, Region 10
1200 6th Avenue
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e-mail: Shephard.Burt@epa.gov

"Facts are stubborn things"
- John Adams

From: Koch, Kristine
Sent: Tuesday, November 04, 2014 12:18 PM
To: Shephard, Burt
Cc: Sheldrake, Sean; Fleming, Sheila
Subject: FW: Manganese memo

Burt, have you completed this review yet?

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: Shephard, Burt
Sent: Thursday, October 30, 2014 8:51 AM
To: John Toll; Koch, Kristine
Cc: Sheldrake, Sean; James McKenna; Bob Wyatt (rjw@nwnatural.com); Jennifer Worenets (jworonets@anchorqea.com); David DeForest

Subject: RE: Manganese memo

Thank you, John.

Hopefully I can finish this up Friday once I'm back in the office.

Best regards,

Burt Shephard
Risk Evaluation Unit
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U.S. Environmental Protection Agency, Region 10
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e-mail: Shephard.Burt@epa.gov

"Facts are stubborn things"
- John Adams

From: John Toll [mailto:JohnT@windwardenv.com]
Sent: Wednesday, October 29, 2014 4:31 PM
To: Koch, Kristine
Cc: Shephard, Burt; Sheldrake, Sean; James McKenna; Bob Wyatt (rjw@nwnatural.com); Jennifer Worenets (jworonets@anchorqea.com); David DeForest
Subject: Manganese memo

Hi Kristine. As you know we've been working with Burt Shephard over the past week or so to answer EPA's questions and incorporate its recommendations into the memo "Derivation of Proposed Manganese PRG to Replace the Suter and Tsao (1996) Tier II Value in the Portland Harbor Feasibility Study." We addressed the questions, incorporated the recommendations, and discussed the revisions with Burt before resubmitting the memo. Having finished that peer review process, the revised manganese memo is attached for your review.

Best regards,

John

John Toll, Ph.D.

Partner, Windward Environmental LLC

200 West Mercer Street, Suite 401 | Seattle, WA 98119

206.812.5433 (o) | 206.913.3292 (c)

johnt@windwardenv.com | www.windwardenv.com

To: Fleming, Sheila[fleming.sheila@epa.gov]
From: Koch, Kristine
Sent: Mon 8/18/2014 4:30:45 PM
Subject: FW: Updated Information re Manganese Aquatic Toxicity
Hardness-based Mn Criterion Memo_01 August 2014.pdf

Deliberative Process / Ex. 5

Thanks,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: James McKenna [mailto:jim.mckenna@verdantllc.com]
Sent: Friday, August 01, 2014 4:04 PM
To: Koch, Kristine
Cc: Sheldrake, Sean; John Toll (JohnT@windwardenv.com); Carl Stivers (cstivers@anchorqea.com); Jennifer Worenets (jworonets@anchorqea.com); Bob Wyatt (rjw@nwnatural.com)

Subject: Updated Information re Manganese Aquatic Toxicity

Kristine:

Per our informal FS technical discussions with EPA, the LWG and EPA agreed that we would generate updated information on manganese aquatic toxicity. This is because the Tier II value that was used in the BERA is 20 years old and there has been a great deal of research on the aquatic toxicity of manganese over the past two decades.

Attached is a memorandum generated by Windward presenting the updated information and a recommendation for the ecological PRG for manganese. The recommended value is calculated using all available aquatic toxicology data in strict accordance with EPA's procedures for deriving ambient water quality criteria. In other words, we believe this approach reflects what EPA's chronic ambient water quality criterion for manganese could be if EPA were to derive the criterion today using its own AWQC methodology (EPA has never derived AWQC for manganese, which is why the Tier II value was used in the BERA). The proposed PRG is hardness dependent. Numerical PRGs for individual transition zone water samples can be calculated easily because we have synoptic hardness and manganese concentration data for those samples.

We can discuss this during our meeting on August 5. If you or anyone on your team has a question before please call me, and if necessary I'll arrange a discussion with John Toll.

Thanks,

Jim McKenna

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Portland, Oregon 97202

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Phone: 206.378.1364 • Fax: 206.973.3048 • www.windwardenv.com

MEMORANDUM

To: Lower Willamette Group

From: John Toll, David DeForest, Brian Church

Subject: Derivation of Proposed Manganese PRG to Replace the Suter and Tsao (1996) Tier II Value in the Portland Harbor Feasibility Study

Date: August 1, 2014

SYNOPSIS

Measured manganese concentrations in the transition zone waters (TZW) of Portland Harbor, Oregon, exceeded the Tier II water quality benchmark developed at Oak Ridge National Laboratory (ORNL) (Suter and Tsao 1996). The Tier II value was derived following US Environmental Protection Agency (EPA) methods (EPA 1993) for chemicals that do not meet the minimum data requirements for development of ambient water quality criteria (AWQC). There is a high degree of uncertainty, associated with the use of this Tier II for decision making. Furthermore, the Tier II value was calculated almost 20 years ago, and sufficient manganese toxicity data are now available. For that reason, the Lower Willamette Group (LWG) and EPA agreed during a May 8, 2014, feasibility study (FS) meeting that the LWG would propose a new manganese water toxicity value. The purpose of this technical memorandum is to present the proposed alternative, hardness-based manganese "criterion."[1]

Studies published subsequent to Suter and Tsao (1996) have shown that hardness plays an important role in mitigating the bioavailability and toxicity of manganese to aquatic organisms (e.g., Stubblefield et al. 1997). At present, both New Mexico and Colorado have adopted hardness-based manganese water quality criteria which have been approved by EPA (CDPHE 2012; NMED 2011), and a biotic ligand model (BLM) for predicting chronic manganese toxicity was recently proposed by Peters et al. (2011).

Using the currently available toxicological data, hardness-based acute and chronic manganese criteria were calculated by Windward Environmental LLC (Windward) using EPA methods (Stephan et al. 1985). Those criteria are presented here. The acute and chronic manganese criteria developed and recommended by Windward are as follows:

$$\textbf{Acute criterion} = e^{(0.7424\,[\ln(\text{hardness})]\,+5.092)}$$

[1] Note that the term "criterion" is used in this memorandum but, while EPA guidelines for AWQC development were followed, the "criterion" derived by Windward Environmental (Windward) have not been reviewed or endorsed by EPA's Office of Water.

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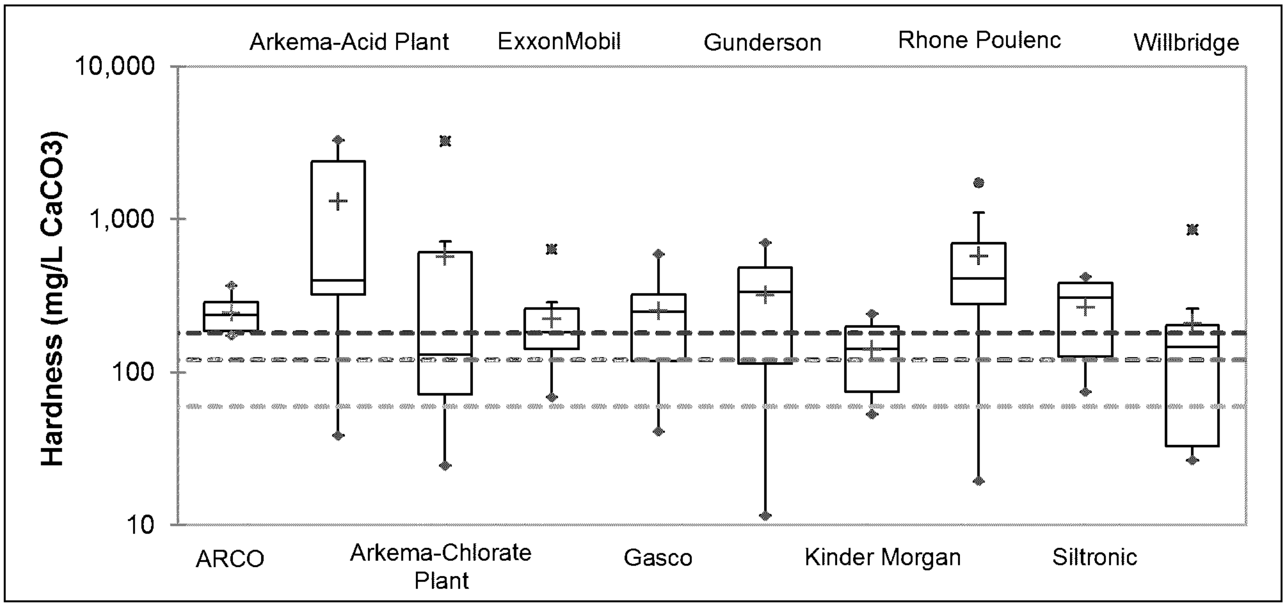
Chronic criterion = $e^{(0.7424 [\ln(\text{hardness})] + 4.220)}$

CURRENT TIER II CRITERION

Chronic Tier II surface water guidelines were developed by Suter and Tsao (1996) as benchmarks for conducting screening-level risk assessments based on surface water chemistry; these guidelines were developed specifically for chemicals with insufficient toxicity data available to develop AWQC. The Tier II secondary chronic value (SCV) for manganese (120 µg/L) was selected as the toxicity reference value (TRV) for the baseline ecological risk assessment (BERA) for Portland Harbor. After reviewing the Tier II SCV value for manganese and the implications of its use in the assessment of risk associated with TZW in Portland Harbor, the benchmark has considerable uncertainty due to the limited dataset it was based upon, and is overly conservative for the hardness values measured in Portland Harbor TZW (Figure 1). Hardness alters manganese toxicity in aquatic systems (Reimer 1999; Stubblefield et al. 1997; Stubblefield and Hockett 2000; Davies 1980), as do several other water chemistry parameters (e.g., pH, free calcium ion, and free potassium ion) (Peters et al. 2011).



Notes: Hardness is shown on logarithmic scale. Dotted lines indicate thresholds between defined water hardness categories: soft (< 60 mg/L as calcium carbonate), moderately hard (60-120 mg/L as calcium carbonate), hard (120-180 mg/L as calcium carbonate), and very hard waters (> 180 mg/L as calcium carbonate). Additional plot symbols are as follows: blue points are minimums and maximums; red plus sign is the arithmetic mean; asterisks are extreme values.

Figure 1. Measured hardness in shallow (0-15-inch) Portland Harbor TZW

The Tier II value of 120 µg/L was calculated using acute toxicity data (i.e., median lethal concentrations [LC50s]) for *Asellus aquaticus* (isopod), *Crangonyx pseudogracilis* (amphipod), *Daphnia magna*, and fathead minnow (*Pimephales promelas*), which ranged from 19,200 to 694,000 µg/L. A chronic toxicity value was available for only fathead minnow; specifically, a chronic value of 1,775 µg/L was included in the dataset and used to calculate an acute-to-chronic ratio (ACR). The Tier II SCV for manganese of 120 µg/L was ultimately derived by dividing the lowest genus (geometric) mean acute value (GMAV) (19,350 µg/L) by an uncertainty factor (8.6) and a mean ACR (18.24) (i.e., the geometric mean of the empirical ACR of 18.93 based on fathead minnow, and two generic ACRs of 17.9).

In the Portland Harbor BERA, TZW concentrations of manganese were compared to the Tier II SCV of 120 µg/L, regardless of other water chemistry parameters that may mediate toxicity in aquatic species (e.g., hardness). Based on the Tier II value, the average hazard quotients (HQs) (ratios of the TZW concentrations to the Tier II SCV) for manganese within Portland Harbor ranged up to 98 .

HARDNESS-BASED MANGANESE CRITERIA FOR NEW MEXICO AND COLORADO

Both New Mexico and Colorado have established hardness-based surface water quality criteria for the protection of aquatic life (CDPHE 2012; NMED 2011) based on a report by Stubblefield and Hockett (2000). The current EPA-approved acute and chronic criteria (expressed as µg/L manganese) in New Mexico/Colorado are as follows:

Acute criterion: $e^{(0.3331[\ln(\text{hardness})] + 6.4676)}$

Chronic criterion: $e^{(0.3331[\ln(\text{hardness})] + 5.8743)}$

RECOMMENDED HARDNESS-BASED MANGANESE CRITERION

This section describes the methods and data used to by Windward to develop the recommended hardness-based manganese criterion for the Portland Harbor remedial investigation (RI)/FS. The criterion is derived following EPA guidance (Stephan et al. 1985) using the New Mexico/Colorado manganese dataset plus additional manganese toxicity test data, many of which are more recent.

Ambient water quality criteria derivation

National AWQC for the protection of aquatic life are derived from empirical toxicity data, and are designed to be stringent enough to protect most sensitive species potentially exposed to a contaminant in any water body in the United States. Below these thresholds, no adverse effects on aquatic communities are anticipated, although because the AWQC concentrations are derived to protect all but the most sensitive species in the toxicity database, the most sensitive species could potentially be impacted. However, if data suggest that a commercially or recreationally important species is not protected at these concentrations, then an AWQC value can be adjusted to provide sufficient protection for these species as well.

EPA guidelines for AWQC development (Stephan et al. 1985) specify minimum study requirements for consideration in the development of acute and chronic criteria for the protection of aquatic life. For example, acute toxicity studies must have an exposure duration of 96 hours (although 48 hours is acceptable for more short-lived species, such as cladocerans and midges); organisms must not be fed during the study; and the endpoint must be mortality, immobilization, or a combination of the two. Chronic toxicity studies must be conducted using exposure durations that encompass the full life cycle or, for fish, early life stage (ELS) and partial life cycle. Although EPA guidelines recommend that ELS tests using fish have exposure durations of 28 to 32 days (60 days post-hatch for salmonids), testing has demonstrated that 7-day survival and growth tests with newly hatched fathead minnows (*Pimephales promelas*) are similar in sensitivity to ELS tests of longer duration (EPA 2002; Norberg and Mount 1985;

Naddy et al. 2007; Stubblefield and Hockett 2000) . Accordingly, 7-day survival and growth tests using *P. promelas* were included in this evaluation. EPA guidelines also stipulate that toxicant concentrations in the exposure solutions must be analytically verified in chronic studies (Stephan et al. 1985). Finally, under the Stephan et al. (1985) guidelines, toxicity studies that do not meet the specific study requirements may still be retained as "other data" if the study was otherwise scientifically valid. Such data are not used to calculate the criterion maximum concentration (CMC) and final chronic value (FCV), but may be used to justify lowering the acute or chronic criteria for a toxicant if the species and endpoint tested are considered to be "biologically or recreationally important," and if the CMC or FCV was determined to be inadequately protective of these species or endpoints.

To understand how AWQC are developed, it is useful to review the guidelines and terminology provided in Stephan et al. (1985); the general approach is briefly summarized below. The first step is to compile acute and chronic toxicity data from laboratory toxicity tests that meet the specific study type and duration requirements noted above. For each species with acceptable acute toxicity data, the species mean acute value (SMAV) is calculated as the geometric mean of the available 48- to 96-hour LC50s and EC50s (median effective concentrations) for each species. The GMAV is then calculated as the geometric mean of the available SMAVs for each genus. The 5th percentile of the distribution of available GMAVs is identified as the final acute value (FAV), which is divided by two (to estimate a low-effect concentration) to determine the CMC, or acute criterion. The 5th percentile is calculated based solely on the four most sensitive GMAVs and the total number of GMAVs (Stephan et al. 1985). AWQC are only developed if an eight family rule is met. When this rule not met, as is often the case for chronic toxicity data, the FCV, or chronic criterion, is derived by dividing the FAV by an ACR. However, if sufficient chronic toxicity data are available, the FCV is calculated in a manner similar to the FAV, using the four lowest genus mean chronic values (GMCVs) and the total number of GMCVs to calculate a 5th percentile value. In the current evaluation, sufficient chronic data were not available to use the latter method to derive a chronic criterion, so an ACR was applied.

Summary of new toxicity studies

An extensive search of available aquatic toxicity data in the literature and online (e.g., ECOTOX 2013) was conducted, and additional unpublished toxicity data used to support development of the manganese criteria adopted in New Mexico and Colorado were also obtained from the New Mexico Environment Department. Several studies were also obtained from Parametrix, Inc. that were sponsored by the International Manganese Institute (IMnI). All acceptable acute and chronic manganese toxicity data were compiled. Those data are presented in Tables 1 (acute data) and 2 (chronic data). Acute toxicity data were identified for 22 species and 21 genera, and the eight family rule was met. Chronic toxicity data were identified for 12 species and genera from 7 families, so the chronic data did not meet the eight family rule (data from a third family in the phylum Chordata were unavailable). Furthermore, chronic data for the amphipod *Hyalella azteca*, which represents one of the seven families with available chronic data, were considered highly unreliable (as discussed later). As such, reliable chronic data were available for only six families. Because the eight family rule was not met for the chronic toxicity dataset, the chronic criterion was developed using an ACR-based approach (EPA 1985). ACRs were identified for six species (Table 3), which meets EPA's minimum requirement of three species ACRs (Stephan et al. 1985).

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Wind Ward environmental LLC

The ranked GMAV values used to calculate the FAV and FCV (using the ACRs in Table 3 to obtain the FCV) are presented in Table 4.

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Table 1. Acute manganese toxicity data

Species	Organism Lifestage/ Size	Exposure Type	Chemical Analysis	Duration (d)	Endpoint	Effect	Hardness (mg/L as $CaCO_3$)	Mn (µg/L)	Mn (µg/L) Adj. to 50 mg/L Hardness (µg/L)	Mn SMAV (µg/L)	Mn GMAV (µg/L)	Reference
Aeolosoma sp. (oligochaete worm)	<24 h	S	M	2	LC50	mortality	52	39,460	38,328	38,328	38,328	Parametrix (2009e)
Agosia chrysogaster (longfin dace)	juveniles	R	M	4	LC50	mortality	224	130,000	42,702	42,702	42,702	Lewis (1978)
Anodonta imbecillis (freshwater mussel)	6-8 days	NR	NR	NR	LC50	mortality	80	36,200	25,537	25,537	25,537	Wade et al. (1989) cited in Stubblefield and Hockett (2000)
Asellus aquaticus (isopod)	adults	R	U	4	LC50	mortality	50	333,000	333,000	333,000	333,000	Martin and Holdich (1986)
Bufo boreus (Western toad)	tadpoles	NR	NR	NR	LC50	mortality	95	339,842	211,027	211,027	211,027	ENSR (1996) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	S	U	2	LC50	mortality	80	19,943	14,068	> 10,889	> 10,889	Hockett and Mount (1996)
Ceriodaphnia dubia (water flea)	neonates	S	U	2	LC50	mortality	172	16,921	6,762	--	--	Hockett and Mount (1996)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	26	8,757	14,229	--	--	ENSR 1992 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	50	12,513	12,513	--	--	ENSR 1992 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	100	20,495	12,251	--	--	ENSR 1992 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	200	25,480	9,104	--	--	ENSR 1992 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	48	15,641	16,122	--	--	ENSR 1990 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	176	28,849	11,334	--	--	ENSR 1990 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	396	>45,000	>9,683	--	--	ENSR 1990 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	NR	LC50	mortality	92	23,456	14,916	--	--	ENSR 1990 cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	R	M	4	LC50	mortality	26	6,700	10,887	--	--	Lasier et al. (2000)
Ceriodaphnia dubia (water flea)	neonates	R	M	4	LC50	mortality	92	14,500	9,221	--	--	Lasier et al. (2000)
Ceriodaphnia dubia (water flea)	neonates	R	M	4	LC50	mortality	184	15,900	6,044	--	--	Lasier et al. (2000)
Chironomus tentans (midge)	juveniles	NR	NR	NR	LC50	mortality	96	327,832	201,993	34,003	34,003	ENSR (1996) cited in Stubblefield and Hockett (2000)
Chironomus tentans (midge)	larvae	S	M	4	LC50	mortality	25	5,800	9,703	--	--	Reimer (1999)
Chironomus tentans (midge)	larvae	S	M	4	LC50	mortality	100	42,200	25,225	--	--	Reimer (1999)
Chironomus tentans (midge)	larvae	S	M	4	LC50	mortality	269	94,300	27,039	--	--	Reimer (1999)
Colisa fasciata (giant gourami)[a]	adults	S	U	4	LC50	mortality	120	1,040,000	542,969	542,969	542,969	Agrawal and Srivastava (1980)
Crangonyx pseudogracilis (amphipod)	adults	R	U	4	LC50	mortality	50	694,000	694,000	694,000	694,000	Martin and Holdich (1986)
Daphnia magna (water flea)	NR	NR	U	2	LC50	mortality	190	42,200	15,664	9,572	9,572	Cabejszek and Stasiak (1960)
Daphnia magna (water flea)	neonates	S	U	2	LC50	mortality	45.3	9,800	10,545	--	--	Biesinger and Christensen (1972)
Daphnia magna (water flea)	neonates	S	M	2	LC50	mortality	26.3	800	1,289	--	--	Reimer (1999)
Daphnia magna (water flea)	neonates	S	M	2	LC50	mortality	100	28,700	17,156	--	--	Reimer (1999)
Daphnia magna (water flea)	neonates	S	M	2	LC50	mortality	267	76,300	22,000	--	--	Reimer (1999)
Duttaphrynus melanostictus (Asian common toad)[a]	tadpole	R	M	4	LC50	mortality	18.6	39,000	81,261	81,261	81,261	Shuhaimi-Othman et al. (2012)
Hyalella azteca (scud)	larvae	S	M	4	LC50	mortality	27.2	3,600	5,657	6,416	6,416	Reimer (1999)
Hyalella azteca (scud)	larvae	S	M	4	LC50	mortality	100	22,200	13,270	--	--	Reimer (1999)
Hyalella azteca (scud)	larvae	S	M	4	LC50	mortality	272	31,000	8,816	--	--	Reimer (1999)
Hyalella azteca (scud)	2-3 mm	NR	NR	NR	LC50	mortality	96	6,630	4,085	--	--	ENSR (1996) cited in Stubblefield and Hockett (2000)
Hyalella azteca (scud)	2-3 mm	NR	NR	NR	LC50	mortality	94	10,169	6,364	--	--	ENSR (1996) cited in Stubblefield and Hockett (2000)
Hyalella azteca (scud)	7 d	R	M	4	LC50	mortality	26	3,000	4,875	--	--	Lasier et al. (2000)
Hyalella azteca (scud)	7 d	R	M	4	LC50	mortality	80	8,559	6,038	--	--	Lasier et al. (2000)
Hyalella azteca (scud)	7 d	R	M	4	LC50	mortality	164	13,700	5,672	--	--	Lasier et al. (2000)
Lymnaea stagnalis (pond snail)	3-4 weeks	R	M	4	LC50	mortality	172	255,530	27,989	27,989	27,989	Parametrix (2009a)

Species	Organism Lifestage/ Size	Exposure Type	Chemical Analysis	Duration (d)	Endpoint	Effect	Hardness (mg/L as $CaCO_3$)	Mn (µg/L)	Mn (µg/L) Adj. to 50 mg/L Hardness (µg/L)	Mn SMAV (µg/L)	Mn GMAV (µg/L)	Reference
Lymnaea stagnalis (pond snail)	3-4 weeks	R	M	4	LC50	mortality	184	205,250	102,121	89,261	89,261	Parametrix (2009a)
Lampsilis siliquoidea (fatmucket clam)	<5 days	S	M	4	LC50	mortality	90	43,300	78,021	--	--	EPA (2010)
Megalonaias nervosa (washboard clam)	<5 days	S	M	4	LC50	mortality	92	31,500	20,032	20,032	20,032	EPA (2010)
Microhyla ornata (frog)[a]	tadpole	R	U	4	LC50	mortality	143.75	14,330	6,543	6,658	6,658	Rao and Madhyastha (1987)
Microhyla ornata (frog)[a]	tadpole	R	U	4	LC50	mortality	143.75	14,840	6,776	--	--	Rao and Madhyastha (1987)
Oncorhynchus kisutch (coho salmon)	juveniles	S	M	4	LC50	mortality	25.2	2,400	3,991	5,481	5,813	Reimer (1999)
Oncorhynchus kisutch (coho salmon)	juveniles	S	M	4	LC50	mortality	100	13,100	7,831	--	--	Reimer (1999)
Oncorhynchus kisutch (coho salmon)	juveniles	S	M	4	LC50	mortality	250	17,400	5,268	--	--	Reimer (1999)
Oncorhynchus mykiss (rainbow trout)	embryos	F	M	4	LC50	mortality	11.8	3,320	9,698	6,165	--	Davies and Brinkman (1994)
Oncorhynchus mykiss (rainbow trout)	NR	F	M	4	LC50	mortality	36	14,500	18,505	--	--	Davies (1980)
Oncorhynchus mykiss (rainbow trout)	NR	F	M	4	LC50	mortality	36	30,000	38,285	--	--	Davies (1980)
Oncorhynchus mykiss (rainbow trout)	NR	F	M	4	LC50	mortality	304	116,000	30,374	--	--	Davies (1980)
Oncorhynchus mykiss (rainbow trout)	juveniles	S	U	4	LC50	mortality	47.6	2,100	2,178	--	--	Reimer (1999)
Oncorhynchus mykiss (rainbow trout)	juveniles	S	U	4	LC50	mortality	100	20,700	12,374	--	--	Reimer (1999)
Oncorhynchus mykiss (rainbow trout)	juveniles	S	U	4	LC50	mortality	259	12,700	3,745	--	--	Reimer (1999)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	44	2,008	2,208	--	--	ENSR (1990) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	48	2,490	2,567	--	--	ENSR (1994) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	90	5,320	3,439	--	--	ENSR (1994) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	170	11,149	4,494	--	--	ENSR (1994) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	100	2,910	1,739	--	--	Birge et al. (1979) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	27.6	3,170	4,928	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	juveniles	NR	NR	NR	LC50	mortality	147.8	16,200	7,246	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	26	3,542	5,755	> 8,274	> 8,274	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	50	6,232	6,232	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	100	9,346	5,587	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	200	15,826	5,655	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	48	10,302	10,619	--	--	ENSR (1990) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	92	17,279	10,988	--	--	ENSR (1990) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	176	27,440	10,781	--	--	ENSR (1990) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	396	>45,000	>9,683	--	--	ENSR (1990) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	juveniles	NR	NR	NR	LC50	mortality	28	8,557	13,160	--	--	ENSR (1996) cited in Stubblefield and Hockett (2000)
Ptychocheilus oregonensis (northern pikeminnow)	juveniles	S	U	4	LC50	mortality	347	130,465	30,966	38,638	38,638	Beleau and Bartosz (1982)
Ptychocheilus oregonensis (northern pikeminnow)	post-larvae	S	U	4	LC50	mortality	316	189,482	48,210	--	--	Beleau and Bartosz (1982)
Salmo trutta (brown trout)	juveniles	F	M	4	LC50	mortality	10.9	9,060	28,070	16,490	16,490	Davies and Brinkman (1994)
Salmo trutta (brown trout)	juveniles	NR	NR	NR	LC50	mortality	48	15,973	16,464	--	--	ENSR (1994) cited in Stubblefield and Hockett (2000)
Salmo trutta (brown trout)	juveniles	NR	NR	NR	LC50	mortality	454	49,900	9,702	--	--	Davies and Brinkman (1995) cited in Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	juveniles	NR	NR	NR	LC50	mortality	48	3,606	3,717	6,917	6,917	ENSR (1994) cited in Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	juveniles	NR	NR	NR	LC50	mortality	31.3	5,120	7,249	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	juveniles	NR	NR	NR	LC50	mortality	148.1	27,500	12,281	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Tubifex tubifex (tubificid worm)	NR	S	U	4	EC50	mortality	237	164,550	51,834	71,122	71,122	Rathore and Khangarot (2002)

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Species	Organism Lifestage/ Size	Exposure Type	Chemical Analysis	Duration (d)	Endpoint	Effect	Hardness (mg/L as $CaCO_3$)	Mn (µg/L)	Mn (µg/L) Adj. to 50 mg/L Hardness (µg/L)	Mn SMAV (µg/L)	Mn GMAV (µg/L)	Reference
Tubifex tubifex (tubificid worm)	NR	S	U	4	EC50	mortality	237	239,270	75,372	--	--	Rathore and Khangarot (2002)
Tubifex tubifex (tubificid worm)	NR	S	U	4	EC50	mortality	237	239,390	75,410	--	--	Rathore and Khangarot (2002)
Tubifex tubifex (tubificid worm)	NR	S	U	4	EC50	mortality	237	275,700	86,847	--	--	Rathore and Khangarot (2002)

[a] Species not found in North America.

EC50 – median effective concentration
F – flow-through exposure
GMAV – genus mean acute value
LC50 – median lethal concentration
M – measured concentration
NR – not reported
R – renewal exposure
S – static exposure
SMAV – species mean acute value
U – unmeasured concentration

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Table 2. Chronic manganese toxicity data

Species	Organism Lifestage	Exposure Type	Chemical Analysis	Duration (days)	Endpoint	Effect	Hardness (mg/L CaCO3)	Mn (ug/L)	Mn (µg/L) Adj. to 50 mg/L Hardness (µg/L)	Mn SMAV (µg/L)	Mn GMAV (µg/L)	Reference
Aeolosoma sp. (oligochaete worm)	<24 h	R	M	14	EC20	population growth	48	3,630	3,742	3,742	3,742	Parametrix (2009f)
Carassius auratus (goldfish)	eggs	R	M	7	LC50	mortality	195	8,220	2,993	2,993	2,993	Birge (1978)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	26	3,314	5,385	3,248	3,248	ENSR (1992) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	50	4,885	4,885	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	100	6,052	3,618	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	200	7,809	2,790	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	46	3,317	3,529	--	--	ENSR (1989) cited in Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	60	1,415.6	1,236	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	24	2,571.0	4,433	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	304	9,255.0	2,423	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	84	3,221.0	2,191	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	12	1,415.0	4,082	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	20	2,803.0	5,534	--	--	Parametrix (2010a)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	2,011	2,073	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	5,203	5,054	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	4,751	4,897	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	200	6,499	2,322	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	44	4,510	4,959	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	3,382	3,285	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	72	4,460	3,402	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	124	7,439	3,790	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	230	9,241	2,976	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	290	16,423	4,454	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	400	5,986	1,279	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	390	11,147	2,426	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	720	4,041	558	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,238	4,116	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	44	2,712	2,982	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,474	4,346	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	76	5,182	3,798	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	116	6,429	3,442	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	212	9,942	3,402	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	284	9,676	2,665	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	384	9,555	2,104	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	410	12,919	2,709	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,572	4,441	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	3,489	3,389	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	5,778	5,612	--	--	Parametrix (2010b)

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Species	Organism Lifestage	Exposure Type	Chemical Analysis	Duration (days)	Endpoint	Effect	Hardness (mg/L CaCO3)	Mn (µg/L)	Mn (µg/L) Adj. to 50 mg/L Hardness (µg/L)	Mn SMAV (µg/L)	Mn GMAV (µg/L)	Reference
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	8,002	7,772	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	7,260	7,483	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,111	3,993	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	2,331	2,264	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	3,319	3,421	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	1,638	1,591	--	--	Parametrix (2010b)
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC25	reproduction	92	5,200	3,307	--	--	Lasier et al. (2000)
Chironomus tentans (midge)	larvae	F	M	54	EC20	mortality	89	17,830	11,621	11,621	11,621	Parametrix (2009g)
Danio rerio (zebrafish)	eggs	F	M	35	EC20	mortality	95	5,121	3,180	3,180	3,180	Parametrix (2009d)
Daphnia magna (water flea)	NR	R	M	21	EC16	reproduction	45.3	4,100	4,412	3,373	3,373	Biesinger and Christensen (1972)
Daphnia magna (water flea)	neonates	S	M	21	IC25	reproduction	100	5,400	3,228	--	--	Reimer (1999)
Daphnia magna (water flea)	neonates	S	M	21	IC25	reproduction	269	9400	2,695	--	--	Reimer (1999)
Hyalella azteca (amphipod)	7-9 day juveniles	F	M	35	EC20	mortality	104	513	361	--[a]	--[a]	Parametrix (2009b)
Lymnaea stagnalis (pond snail)	<24 h	R	M	30	EC20	growth	174	9,040	3,582	3,582	3,582	Parametrix (2009c)
Oncorhynchus mykiss (rainbow trout)	embryos	F	M	121.76	MATC	mortality	36.8	1,570	1,971	1,665	1,665	Davies and Brinkman (1994)
Oncorhynchus mykiss (rainbow trout)	embryos	F	M	121.76	MATC	mortality	36.8	790	992	--	--	Davies and Brinkman (1994)
Oncorhynchus mykiss (rainbow trout)	embryos	NR	NR	NR	EC20	growth	29	1,398	2,095	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	embryos	NR	NR	NR	EC20	growth	151	4,259	1,875	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	embryos	NR	NR	NR	EC20	growth	30	2,550	3,726	2,659	2,659	ENSR (1996) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	26	1,338	2,174	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	50	5,490	5,490	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	100	5,120	3,061	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	200	13,152	4,699	--	--	ENSR (1992) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	46	3,417	3,635	--	--	ENSR (1989) cited in Stubblefield and Hockett (2000)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	3,117	4,341	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	104	8,010	4,651	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	3,145	4,380	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	60	6,222	5,434	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	9,525	5,694	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	192	8,828	3,251	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	244	7,861	2,423	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	292	7,742	2,089	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	400	6,991	1,493	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	372	1,928	435	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	672	8,287	1,204	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	204	1,573	554	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	396	1,776	382	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,137	2,976	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	52	1,333	1,295	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	1,186	1,652	--	--	Parametrix (2010c)

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Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	36	2,147	2,740	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	52	2,388	2,319	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	430	599	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	92	8,587	5,461	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	200	12,860	4,595	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,648	3,688	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,463	3,430	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	5,099	3,048	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	8,501	5,082	--	--	Parametrix (2010c)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	60	2,985.0	2,607	--	--	Parametrix (2010d)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	24	2,068.0	3,566	--	--	Parametrix (2010d)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	312	27,604.0	7,090	--	--	Parametrix (2010d)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	88	7,054.0	4,636	--	--	Parametrix (2010d)
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	12	1,078.0	3,110	--	--	Parametrix (2010d)
Salmo trutta (brown trout)	juveniles	F	M	121.76	MATC	mortality	37.5	2,700	3,343	4,104	4,104	Davies and Brinkman (1994)
Salmo trutta (brown trout)	juveniles	F	M	121.76	MATC	mortality	37.5	4,190	5,188	--	--	Davies and Brinkman (1994)
Salmo trutta (brown trout)	eyed eggs	F	M	62	IC25	survival and weight	30.9	4,670	6,675	--	--	Stubblefield et al. (1997)
Salmo trutta (brown trout)	eyed eggs	F	M	62	IC25	survival and weight	151.8	5,590	2,451	--	--	Stubblefield et al. (1997)
Salvelinus fontinalis (brook trout)	embryos	NR	NR	NR	EC20	growth	32	2,104	2,930	2,157	2,157	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	embryos	NR	NR	NR	EC20	growth	156	3,695	1,588	--	--	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)

[a] *H. azteca* SMAV and GMAV excluded from evaluation (see text).

EC – effective concentration
F – flow-through exposure
GMAV – geometric mean acute value
IC – inhibitory concentration
LC – lethal concentration
LOEC – lowest-observed-effects concentration
M – measured concentration
MATC – maximum acceptable toxicant concentration
na – not applicable
NOEC – no-observed-effects concentration
NR – not reported
R – renewal exposure
S – static exposure
SMAV – species mean acute value
U – unmeasured concentration

Table 3. Acute-to-chronic ratios

Species	Hardness (mg/L)	Acute Value (µg/L)	Chronic Value (µg/L)	ACR	Species Mean ACR	Reference
Ceriodaphnia dubia (water flea)	26	8,757	3,314	2.642	3.153	Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	50	12,513	4,885	2.562	--	Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	100	20,495	6,052	3.386	--	Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	200	25,480	7,809	3.263	--	Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	48	15,641	3,317	4.715	--	Stubblefield and Hockett (2000)
Ceriodaphnia dubia (water flea)	92	14,500	5,200	2.788	--	Lasier et al. (2000)
Daphnia magna (water flea)	45.3	9,800	4,100	2.390	4.689	Biesinger and Christensen (1972)
Pimephales promelas (fathead minnow)	"HARD"	33,603	1,770	18.98	18.98	Kimball (1978)
Salmo trutta (brown trout)	48	15,973	4,670	3.4203	3.42	Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	31.3	5,120	2,104	2.4335	4.26	Stubblefield and Hockett (2000)
Salvelinus fontinalis (brook trout)	148.1	27,500	3,695	7.4425	--	Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	27.6	3,170	1,398	2.2675	2.94	Stubblefield and Hockett (2000)
Oncorhynchus mykiss (rainbow trout)	147.8	16,200	4,259	3.8037	--	Stubblefield and Hockett (2000)
Geometric mean ACR					4.78	

ACR – acute-to-chronic ratio
AWQC – ambient water quality criteria
EPA – US Environmental Protection Agency
na – not applicable

Table 4. Ranked acute manganese toxicity data with FAV and CMC Values

Rank	Mn GMAV (µg/L)[a]	Species	Mn SMAV (µg/L)[a]
22	694,000	*Crangonyx pseudogracilis* (amphipod)	694,000
21	542,969	*Colisa fasciata* (giant gourami)[b]	540,902
20	333,000	*Asellus aquaticus* (isopod)	333,000
19	211,027	*Bufo boreus* (Western toad)	210,438
18	89,261	*Lymnaea stagnalis* (pond snail)	88,769
17	81,261	*Duttaphrynus melanostictus* (Asian common toad)[b]	81,612
16	71,122	*Tubifex tubifex* (tubificid worm)	70,641
15	42,702	*Agosia chrysogaster* (longfin dace)	42,424
14	38,638	*Ptychocheilus oregonensis* (northern pikeminnow)	38,321
13	38,328	*Aeolosoma* sp. (oligochaete worm)	38,321
12	34,003	*Chironomus tentans* (midge)	33,917
11	27,989	*Lampsilis siliquoidea* (fatmucket clam)	27,917
10	25,537	*Anodonta imbecillis* (freshwater mussel)	25,485
9	20,032	*Megalonaias nervosa* (washboard clam)	19,979
8	16,490	*Salmo trutta* (brown trout)	16,474
7	> 10,889	*Ceriodaphnia dubia* (water flea)	> 10,859
6	9,572	*Daphnia magna* (water flea)	9,547

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Rank	Mn GMAV (µg/L)[a]	Species	Mn SMAV (µg/L)[a]
5	> 8,274	*Pimephales promelas* (fathead minnow)	> 8,255
4	6,917	*Salvelinus fontinalis* (brook trout)	6,911
3	6,658	*Microhyla ornata* (frog)[b]	6,628
2	6,416	*Hyalella azteca* (scud)	6,402
1	5,813	*Oncorhynchus kisutch* (coho salmon)	5,468
--	--	*Oncorhynchus mykiss* (rainbow trout)	6,156
FAV			**5,940**
CMC			**2,970**

[a] Acute toxicity values were normalized (within species) to a standard hardness (50 mg/L as calcium carbonate) prior to averaging following EPA methods (Stephan et al. 1985).

[b] Species not found in North America.

CMC – criterion maximum concentration
EPA – US Environmental Protection Agency
FAV – final acute value
GMAV – genus mean acute value
SMAV – species mean acute value

Hardness-toxicity relationships

Method

The relationship between hardness and manganese toxicity values was determined following EPA methods for AWQC development (Stephan et al. 1985). The general approach to derive hardness-dependent criteria entails the use of an analysis of covariance to derive a log-linear slope that quantitatively relates standard toxicity values (e.g., LC50s) to water hardness (see Table 1 for available data). To evaluate whether there is a significant statistical relationship between hardness and toxicity, there must be definitive toxicity values (i.e., undefined "less than" or "greater than" toxicity values may not be used) from toxicity studies that expose organisms over a range of water hardness values; the highest hardness must be at least three times greater than the lowest, and the highest hardness must also be at least 100 mg/L (as calcium carbonate) greater than the lowest.

The pooled slope of the relationship between hardness-normalized acute toxicity data[2] and logarithmically transformed hardness was calculated as 0.7424. Data were too limited to develop a separate hardness slope for chronic toxicity, so the acute hardness slope of 0.7424 was assumed. This is consistent with EPA guidance (Stephan et al. 1985).

The following sections describe the acute and chronic hardness-dependent criteria determined by Windward.

Acute criterion

The acute manganese toxicity values were normalized to a common hardness of 50 mg/L (as calcium carbonate) using the pooled slope of 0.7424, and the GMAVs were calculated based on

[2] Standard toxicity values (e.g., LC50s) were normalized within species and then pooled across species when developing the hardness-toxicity relationship slope. Species slopes were not statistically different.

the hardness-normalized values (Table 1). The GMAVs were then ranked from high to low, and a FAV of 5,940 µg/L was calculated based on the four lowest GMAVs (Table 4). The FAV was then divided by two in order to derive a CMC (acute criterion) of 2,970 µg/L. This CMC is based on a hardness of 50 mg/L, but the following equation can be used to derive the CMC at the hardness of interest:

$$\textbf{Acute criterion} = e^{(0.7467[\ln(\text{hardness})] + 5.092)}$$

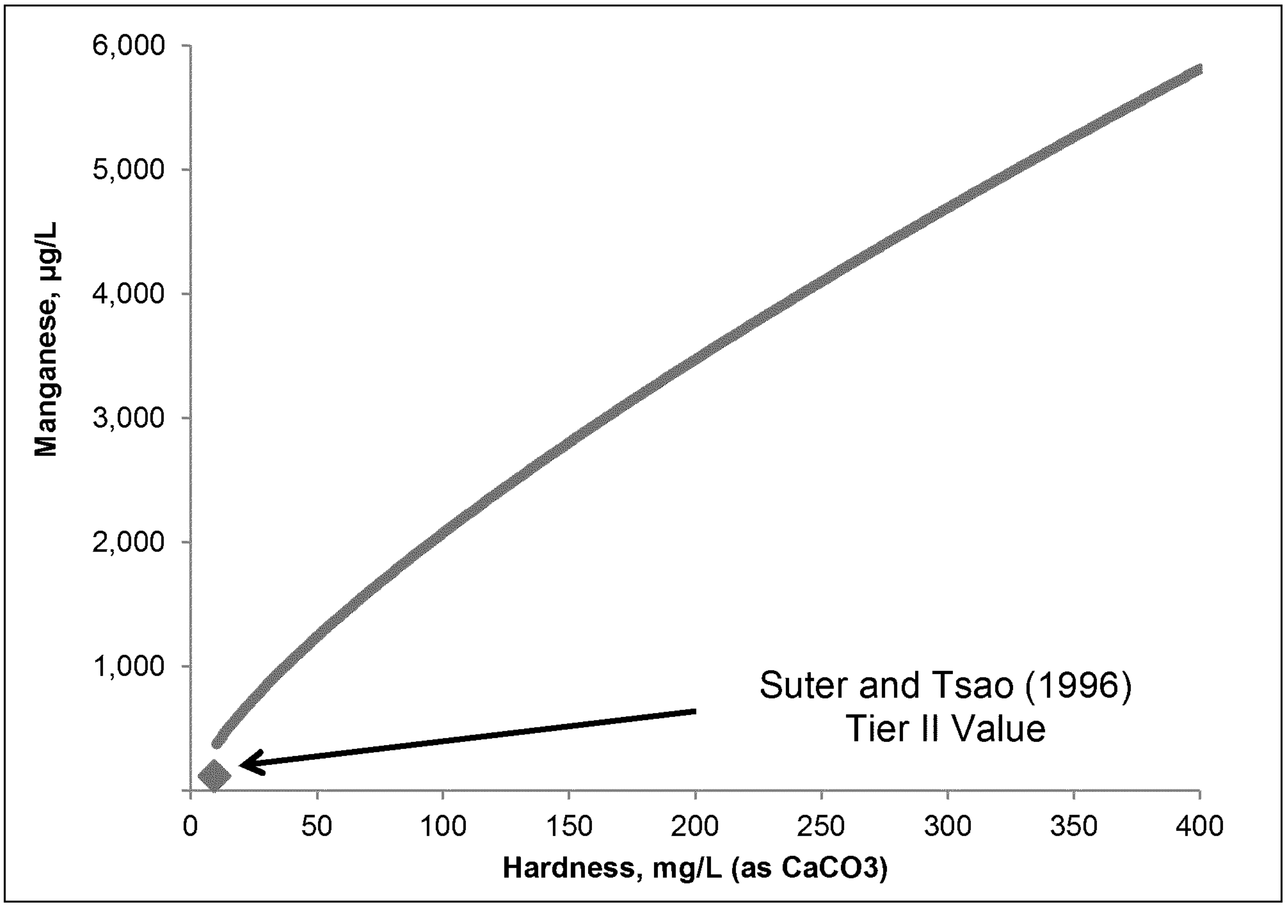
Chronic criterion

In order to derive a FCV (chronic criterion), the FAV of 5,940 µg/L at a hardness of 50 mg/L (as calcium carbonate) was divided by the final ACR of 4.78 (Table 3). The resulting FCV was 1,241 µg/L (based on a hardness of 50 mg/L). The following equation can be used to derive the FCV at the hardness of interest:

$$\textbf{Chronic criterion} = e^{(0.7424[\ln(\text{hardness})] + 4.220)}$$

The recommended chronic criterion is plotted as a function of hardness in Figure 2.

Because the chronic manganese criteria discussed in this evaluation were derived using acute hardness slopes and ACRs, the empirical chronic value (e.g., 20th percentile effective concentration [EC20], etc.) were compared to the corresponding hardness-based chronic criteria at the reported test hardness in order to ensure that the chronic criteria are appropriately protective. The ratio of each individual chronic value to its corresponding hardness-based criterion was calculated, and a ratio of < 1 indicated that the criterion would not have been protective of that particular chronic toxicity value. In some instances, use of the Windward chronic criterion was found to produce potentially under-protective individual toxicity values for rainbow trout (*Oncorhynchus mykiss*) (1 of 4 test results [25%]), *Ceriodaphnia dubia* (2 of 43 test results [5%]), and fathead minnow (*Pimephales promelas*) (5 of 36 test results [15%]); otherwise, use of the Windward chronic criterion produced toxicity values sufficiently protective of these species on average across all tests (Table 5). The chronic criterion would not produce the available chronic toxicity value protective of *H. azteca*, which was the lowest toxicity value identified. However, as discussed in the following section, there is considerable uncertainty in the chronic manganese value for *H. azteca*, and that value was excluded from this evaluation (i.e., consistent with EPA guidance it was not deemed necessary to lower the recommended chronic manganese criterion in order to ensure protection of this species).



Note: Orange diamond represents current Tier II manganese value (Suter and Tsao 1996) applied in the BERA. The Tier II hardness value of approximately 9.3 mg/L (as calcium carbonate) was calculated by setting the Windward criterion equal to the Tier II value of 120 µg manganese/L and solving for the hardness. This hardness value is less th an the minimum observed hardness in Portland Harbor TZW samples (11.5 mg/L as calcium carbonate).

Figure 2. Recommended hardness-based chronic manganese criterion

Table 5. Ratio of hardness-based manganese criteria to empirical chronic toxicity data

Species	Organism Lifestage	Exposure Type	Chemical Analysis	Duration (days)	Endpoint	Effect	Hardness (mg/L CaCO3)	Mn (ug/L)	Reference	Windward Criterion	New Mexico/ Colorado Criterion	Chronic Value-to-Windward Criterion Ratio	Chronic Value-to-New Mexico/ Colorado Criterion Ratio
Aeolosoma sp. (oligochaete worm)	<24 h	R	M	14	EC20	population growth	48	3,630	Parametrix (2009f)	1,205	1,292	3.0	2.8
Carassius auratus (goldfish)	eggs	R	M	7	LC50	mortality	195	8,220	Birge (1978)	3,411	2,061	2.4	4.0
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	26	3,314	ENSR (1992) cited in Stubblefield and Hockett (2000)	764	1,053	4.3	3.1
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	50	4,885	ENSR (1992) cited in Stubblefield and Hockett (2000)	1,242	1,309	3.9	3.7
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	100	6,052	ENSR (1992) cited in Stubblefield and Hockett (2000)	2,077	1,650	2.9	3.7
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	200	7,809	ENSR (1992) cited in Stubblefield and Hockett (2000)	3,475	2,078	2.2	3.8
Ceriodaphnia dubia (water flea)	neonates	NR	NR	7	EC20	growth	46	3,317	ENSR (1989) cited in Stubblefield and Hockett (2000)	1,167	1,274	2.8	2.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	60	1,415.6	Parametrix (2010a)	1,422	1,391	**< 1.0**	1.0
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	24	2,571.0	Parametrix (2010a)	720	1,025	3.6	2.5
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	304	9,255.0	Parametrix (2010a)	4,743	2,389	2.0	3.9
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	84	3,221.0	Parametrix (2010a)	1,825	1,557	1.8	2.1
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	12	1,415.0	Parametrix (2010a)	430	814	3.3	1.7
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	20	2,803.0	Parametrix (2010a)	629	965	4.5	2.9
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	2,011	Parametrix (2010b)	1,205	1,292	1.7	1.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	5,203	Parametrix (2010b)	1,278	1,327	4.1	3.9
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	4,751	Parametrix (2010b)	1,205	1,292	3.9	3.7
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	200	6,499	Parametrix (2010b)	3,475	2,078	1.9	3.1
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	44	4,510	Parametrix (2010b)	1,129	1,255	4.0	3.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	3,382	Parametrix (2010b)	1,278	1,327	2.6	2.5
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	72	4,460	Parametrix (2010b)	1,628	1,479	2.7	3.0
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	124	7,439	Parametrix (2010b)	2,437	1,772	3.1	4.2
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	230	9,241	Parametrix (2010b)	3,855	2,177	2.4	4.2
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	290	16,423	Parametrix (2010b)	4,579	2,352	3.6	7.0
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	400	5,986	Parametrix (2010b)	5,814	2,618	1.0	2.3
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	390	11,147	Parametrix (2010b)	5,706	2,596	2.0	4.3
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	720	4,041	Parametrix (2010b)	8,995	3,184	**0.4**	1.3
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,238	Parametrix (2010b)	1,278	1,327	3.3	3.2
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	44	2,712	Parametrix (2010b)	1,129	1,255	2.4	2.2
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,474	Parametrix (2010b)	1,278	1,327	3.5	3.4
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	76	5,182	Parametrix (2010b)	1,694	1,505	3.1	3.4
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	116	6,429	Parametrix (2010b)	2,319	1,733	2.8	3.7
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	212	9,942	Parametrix (2010b)	3,629	2,119	2.7	4.7
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	284	9,676	Parametrix (2010b)	4,509	2,335	2.1	4.1
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	384	9,555	Parametrix (2010b)	5,641	2,582	1.7	3.7
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	410	12,919	Parametrix (2010b)	5,922	2,639	2.2	4.9
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,572	Parametrix (2010b)	1,278	1,327	3.6	3.4
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	3,489	Parametrix (2010b)	1,278	1,327	2.7	2.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	5,778	Parametrix (2010b)	1,278	1,327	4.5	4.4

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Species	Organism Lifestage	Exposure Type	Chemical Analysis	Duration (days)	Endpoint	Effect	Hardness (mg/L CaCO3)	Mn (ug/L)	Reference	Windward Criterion	New Mexico/ Colorado Criterion	Chronic Value-to-Windward Criterion Ratio	Chronic Value-to-New Mexico/ Colorado Criterion Ratio
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	8,002	Parametrix (2010b)	1,278	1,327	6.3	6.0
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	7,260	Parametrix (2010b)	1,205	1,292	6.0	5.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	4,111	Parametrix (2010b)	1,278	1,327	3.2	3.1
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	2,331	Parametrix (2010b)	1,278	1,327	1.8	1.8
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	48	3,319	Parametrix (2010b)	1,205	1,292	2.8	2.6
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC20	reproduction	52	1,638	Parametrix (2010b)	1,278	1,327	1.3	1.2
Ceriodaphnia dubia (water flea)	neonates	R	M	7	EC25	reproduction	92	5,200	Lasier et al. (2000)	1,953	1,604	2.7	3.2
Chironomus tentans (midge)	larvae	F	M	54	EC20	mortality	89	17,830	Parametrix (2009g)	1,905	1,587	9.4	11.2
Danio rerio (zebrafish)	eggs	F	M	35	EC20	mortality	95	5,121	Parametrix (2009d)	2,000	1,622	2.6	3.2
Daphnia magna (water flea)	NR	R	M	21	EC16	reproduction	45.3	4,100	Biesinger and Christensen (1972)	1,154	1,267	3.6	3.2
Daphnia magna (water flea)	neonates	S	M	21	IC25	reproduction	100	5,400	Reimer (1999)	2,077	1,650	2.6	3.3
Daphnia magna (water flea)	neonates	S	M	21	IC25	reproduction	269	9,400	Reimer (1999)	4,331	2,294	2.2	4.1
Hyalella azteca (amphipod)	7-9 day juveniles	F	M	35	EC20	growth	104	513	Parametrix (2009b)			**0.2**	**0.3**
Lymnaea stagnalis (pond snail)	<24 h	R	M	30	EC20	growth	174	9,040	Parametrix (2009c)	3,134	1,984	2.9	4.6
Oncorhynchus mykiss (rainbow trout)	embryos	F	M	121.76	MATC	mortality	36.8	1,570	Davies and Brinkman (1994)	989	1,182	1.6	1.3
Oncorhynchus mykiss (rainbow trout)	embryos	F	M	121.76	MATC	mortality	36.8	790	Davies and Brinkman (1994)	989	1,182	**0.8**	**0.7**
Oncorhynchus mykiss (rainbow trout)	embryos	NR	NR	NR	EC20	growth	29	1,398	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)	829	1,092	1.7	1.3
Oncorhynchus mykiss (rainbow trout)	embryos	NR	NR	NR	EC20	growth	151	4,259	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)	2,821	1,892	1.5	2.3
Pimephales promelas (fathead minnow)	embryos	NR	NR	NR	EC20	growth	30	2,550	ENSR (1996) cited in Stubblefield and Hockett (2000)	850	1,105	3.0	2.3
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	26	1,338	ENSR (1992) cited in Stubblefield and Hockett (2000)	764	1,053	1.8	1.3
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	50	5,490	ENSR (1992) cited in Stubblefield and Hockett (2000)	1,242	1,309	4.4	4.2
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	100	5,120	ENSR (1992) cited in Stubblefield and Hockett (2000)	2,077	1,650	2.5	3.1
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	200	13,152	ENSR (1992) cited in Stubblefield and Hockett (2000)	3,475	2,078	3.8	6.3
Pimephales promelas (fathead minnow)	larvae	NR	NR	NR	EC20	growth	46	3,417	ENSR (1989) cited in Stubblefield and Hockett (2000)	1,167	1,274	2.9	2.7
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	3,117	Parametrix (2010c)	892	1,129	3.5	2.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	104	8,010	Parametrix (2010c)	2,139	1,671	3.7	4.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	3,145	Parametrix (2010c)	892	1,129	3.5	2.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	60	6,222	Parametrix (2010c)	1,422	1,391	4.4	4.5
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	9,525	Parametrix (2010c)	2,077	1,650	4.6	5.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	192	8,828	Parametrix (2010c)	3,372	2,050	2.6	4.3
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	244	7,861	Parametrix (2010c)	4,028	2,220	2.0	3.5
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	292	7,742	Parametrix (2010c)	4,603	2,357	1.7	3.3
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	400	6,991	Parametrix (2010c)	5,814	2,618	1.2	2.7
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	372	1,928	Parametrix (2010c)	5,509	2,555	**0.3**	**0.8**
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	672	8,287	Parametrix (2010c)	8,546	3,112	**< 1.0**	2.7
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	204	1,573	Parametrix (2010c)	3,527	2,092	**0.4**	**0.8**
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	396	1,776	Parametrix (2010c)	5,771	2,609	**0.3**	**0.7**
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,137	Parametrix (2010c)	892	1,129	2.4	1.9
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	52	1,333	Parametrix (2010c)	1,278	1,327	1.0	1.0

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Species	Organism Lifestage	Exposure Type	Chemical Analysis	Duration (days)	Endpoint	Effect	Hardness (mg/L CaCO3)	Mn (ug/L)	Reference	Windward Criterion	New Mexico/ Colorado Criterion	Chronic Value-to-Windward Criterion Ratio	Chronic Value-to-New Mexico/ Colorado Criterion Ratio
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	1,186	Parametrix (2010c)	892	1,129	1.3	1.1
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	36	2,147	Parametrix (2010c)	973	1,174	2.2	1.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	52	2,388	Parametrix (2010c)	1,278	1,327	1.9	1.8
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	430	Parametrix (2010c)	892	1,129	**0.5**	**0.4**
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	92	8,587	Parametrix (2010c)	1,953	1,604	4.4	5.4
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	200	12,860	Parametrix (2010c)	3,475	2,078	3.7	6.2
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,648	Parametrix (2010c)	892	1,129	3.0	2.3
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	32	2,463	Parametrix (2010c)	892	1,129	2.8	2.2
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	5,099	Parametrix (2010c)	2,077	1,650	2.5	3.1
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	100	8,501	Parametrix (2010c)	2,077	1,650	4.1	5.2
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	60	2,985.0	Parametrix (2010d)	1,422	1,391	2.1	2.1
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	24	2,068.0	Parametrix (2010d)	720	1,025	2.9	2.0
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	312	27,604.0	Parametrix (2010d)	4,835	2,410	5.7	11.5
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	88	7,054.0	Parametrix (2010d)	1,889	1,581	3.7	4.5
Pimephales promelas (fathead minnow)	larvae	R	M	7	EC20	growth	12	1,078.0	Parametrix (2010d)	430	814	2.5	1.3
Salmo trutta (brown trout)	juveniles	F	M	121.76	MATC	mortality	37.5	2,700	Davies and Brinkman (1994)	1,003	1,190	2.7	2.3
Salmo trutta (brown trout)	juveniles	F	M	121.76	MATC	mortality	37.5	4,190	Davies and Brinkman (1994)	1,003	1,190	4.2	3.5
Salmo trutta (brown trout)	eyed eggs	F	M	62	IC25	survival and weight	30.9	4,670	Stubblefield et al. (1997)	869	1,116	5.4	4.2
Salmo trutta (brown trout)	eyed eggs	F	M	62	IC25	survival and weight	151.8	5,590	Stubblefield et al. (1997)	2,832	1,896	2.0	2.9
Salvelinus fontinalis (brook trout)	embryos	NR	NR	NR	EC20	growth	32	2,104	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)	892	1,129	2.4	1.9
Salvelinus fontinalis (brook trout)	embryos	NR	NR	NR	EC20	growth	156	3,695	Davies and Brinkman (1998) cited in Stubblefield and Hockett (2000)	2,890	1,913	1.3	1.9

Note: Chronic value-to-criterion ratios equal the manganese concentration (for the given endpoint) divided by the hardness-based criterion (at the test hardness). **Bold** ratios indicate an instance where the criterion would be under-protective (i.e., ratio < 1.0).

EC – effective concentration
F – flow through exposure
IC – inhibitory concentration
LC – lethal concentration
M – measured concentration
MATC – maximum acceptable toxicant concentration
nr – not reported
R – renewal exposure
S – static exposure
U – unmeasured concentration

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SENSITIVITY OF *HYALELLA AZTECA* TO MANGANESE: VARIABILITY AND UNCERTAINTY

As noted above, the amphipod *Hyalella azteca* is the species most sensitive to manganese in chronic exposures, based on a 42-day life cycle test (Parametrix 2009b). However, there are several uncertainties relating to the toxicity value(s) that can be derived from this test, in large part related to issues associated with the toxicity test method, specifically the standard test diet. Due to these uncertainties, chronic manganese data for *H. azteca* were excluded from manganese "criteria" development in this evaluation. The following documents chronic data available for *H. azteca* and the associated uncertainties.

In the 42-day life cycle test using *H. azteca*, test organisms are exposed to the test solution in chambers containing sediment for 28 days, at which point live and dead organisms are recovered. Amphipods from a subset of replicates are measured for growth. Live organisms among the remaining replicates are then placed back in the chambers for the remaining 14 days of exposure (with sediment excluded), which represents the reproductive phase of the test. Overall, the endpoints measured are 1) survival and growth after 28 days; 2) survival and reproduction after 35 days; and 3) survival, growth, and reproduction after 42 days. The test is considered acceptable if control survival is ≥ 80% after 28 days. Although not specifically a test acceptability requirement, the test method also notes that reproduction from days 28 to 42 generally results in more than two young per female (EPA 2000). In the Parametrix (2009b) test, control survival was 91% after 28 days and decreased to 81 and 51% after 35 and 42 days, respectively. Control reproduction after 42 days was 1.55 young per female. Therefore, the test met acceptability requirements based on control survival after 28 days, but survival had decreased substantially (to 51%) by day 42 of the test. Control reproduction was less than the typically desired level.

Various manganese effects concentrations for *H. azteca* can be derived from Parametrix (2009b) based on the different endpoints and time points. As available, EC20s were the preferred statistic for the purpose of this evaluation. The EC20s for survival after 28, 35, and 42 days were 753, 513, and 256 µg/L, respectively. Because control survival decreased substantially from 81% at day 35 to 51% at day 42, the EC20 of 513 µg/L on day 35 was considered the most reliable for the survival endpoint. Growth, in terms of both biomass (dry weight per original organism) and dry weight (per surviving organism), was considered a less sensitive endpoint than survival, with 28-day EC20s of 1,610 and 1,949 µg/L, respectively (EC20s could not be determined based on day 42 data due to lack of a concentration-response relationship). Parametrix (2009b) noted that one replicate in the 1,403 µg Mn/L treatment had high dry weights (i.e., greater than the majority of control replicates). When this replicate was excluded, the biomass and dry weight EC20s decreased to 1,249 and 203 µg/L, respectively. The latter is less than the survival EC20 of 513 µg/L based on day 35, and also less than the day 42 growth (dry weight) no-observed-effects concentration (NOEC) of > 285.9 µg/L. Accordingly, the dry weight EC20 with the one replicate removed was not considered a reliable toxicity threshold for growth effects. Finally, no significant effects ($p > 0.05$) on reproduction were observed at day 42, and an EC20 could not be determined (and, as discussed above, control reproduction was less than the typically desired level). Overall, the most reliable manganese EC20 from this test was determined to be the day 35 EC20 of 513 µg/L for survival.

For comparison to the Parametrix (2009b) *H. azteca* test, Norwood et al. (2007) tested the effects of manganese on *H. azteca* survival and growth following 28-day exposures in two different test containers (glass and high-density polyethylene [HDPE]). They reported manganese LC25s (25% lethal concentrations) of 532 and 8,076 µg/L for amphipods exposed to manganese in glass and HDPE containers, respectively, and IC25s (25% inhibition concentrations) of 116 and 7,032 µg/L for growth of amphipods exposed in glass and HDPE containers, respectively. The LC25 for amphipods in glass containers was comparable to the EC20 for survival in the Parametrix (2009b) test, while the IC25 for growth was less than that observed in the Parametrix (2009b) test. However, the much greater LC25 and IC25 in the HDPE container compared to the glass container are puzzling, as manganese concentrations in the test waters were analytically verified (i.e., the difference does not appear to be an artifact of manganese binding to the walls of one container type much more than the other). Furthermore, manganese concentrations were measured in the amphipods following the 28-day exposure, and concentrations appeared to be comparable in both exposure systems (again suggesting that the manganese exposures were comparable between the two types of containers). This suggests that the differences in the toxicity values between the two container types may be due to a factor other than manganese. However, this is uncertain; Norwood et al. (2007), likewise, did not have an explanation.

The chronic studies conducted by Parametrix (2009b) and Norwood et al. (2007) each contained uncertainties. The former included poor 42-day survival and low reproduction, while the latter resulted in large differences in effects between exposure container types. In addition to these uncertainties, there has recently been much discussion on the importance of diet in *H. azteca* tests, further raising questions as to the organism's chronic sensitivity to manganese. The EPA laboratory in Duluth, Minnesota, has recently been conducting research relative to diet in the 42-day *H. azteca* toxicity test. Hockett et al. (2011) conducted several 42-day tests using various diets, including diatoms, wheatgrass, TetraMin, YCT (Yeast, Cerophyl®, and Trout Chow), and several of these foods in combination. They found that the standard fixed ration of 1 ml YCT/chamber-day (the diet used by Parametrix (2009b)) limited amphipod growth and reproduction in the latter portions of the 42-day exposure, and they observed greater growth and reproduction with a variety of alternate foods or feeding schedules. For example they observed the reproduction of more than 10 young per female, while Parametrix (2009b) observed only 1.55 young per female in the controls fed the 1 mL YCT diet. As an result of these same studies, David Mount (EPA-Duluth) recommended that the Great Lakes National Program Office consider the diet and water used in testing with *H. azteca* adequate if 42-day survival is ≥ 80%, weights are > 0.3 mg dry weight (dw)/individual at 28 days and > 0.5 mg dw/individual at 42 days, and mean reproduction is more than 4 young per female (Mount 2011). None of these parameters were achieved in the Parametrix (2009b) study based on the standard 1 mL YCT diet.

For all of the above reasons, chronic manganese toxicity data for *H. azteca* were excluded from the derivation of a chronic manganese "criterion."

RECOMMENDATION

Several studies have shown a relationship between manganese toxicity and water hardness (Stubblefield et al. 1997; Reimer 1999; Peters et al. 2011). We recommend that the hardness-based criterion we have derived be used to replace the Tier II value of 120 µg/L derived by

Suter and Tsao (1996). The manganese chronic criterion developed in this memorandum and recommended for the ecological PRG is calculated according to EPA's methods (Stephan et al. 1985) and is based on a larger and more up-to-date toxicity database that existing hardness-based criteria. Therefore, as per the direction received from EPA at the May 8, 2014 LWG-EPA FS meeting, Windward recommends that the chronic, hardness-based criterion developed herein replace the Tier II value as the ecological PRG for use in the Portland Harbor FS.

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To: Shephard, Burt[Shephard.Burt@epa.gov]
Cc: Fleming, Sheila[fleming.sheila@epa.gov]
From: Koch, Kristine
Sent: Wed 8/6/2014 3:22:38 PM
Subject: FW: Updated Information re Manganese Aquatic Toxicity
Hardness-based Mn Criterion Memo_01 August 2014.pdf

Burt, Can you let me know when you will have time to review this information? I need it complete by August 22. Thanks,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: James McKenna [mailto:jim.mckenna@verdantllc.com]
Sent: Friday, August 01, 2014 4:04 PM
To: Koch, Kristine
Cc: Sheldrake, Sean; John Toll (JohnT@windwardenv.com); Carl Stivers (cstivers@anchorqea.com); Jennifer Worenets (jworonets@anchorqea.com); Bob Wyatt (rjw@nwnatural.com)
Subject: Updated Information re Manganese Aquatic Toxicity

Kristine:

Per our informal FS technical discussions with EPA, the LWG and EPA agreed that we would generate updated information on manganese aquatic toxicity. This is because the Tier II value that was used in the BERA is 20 years old and there has been a great deal of research on the aquatic toxicity of manganese over the past two decades.

Attached is a memorandum generated by Windward presenting the updated information and a recommendation for the ecological PRG for manganese. The recommended value is calculated using all available aquatic toxicology data in strict accordance with EPA's procedures for deriving ambient water quality criteria. In other words, we believe this approach reflects what EPA's chronic ambient water quality criterion for manganese could be if EPA were to derive the criterion today using its own AWQC methodology (EPA has never derived AWQC for manganese, which is why the Tier II value was used in the BERA). The proposed PRG is hardness dependent. Numerical PRGs for individual transition zone water samples can be calculated easily because we have synoptic hardness and manganese concentration data for those samples.

We can discuss this during our meeting on August 5. If you or anyone on your team has a question before please call me, and if necessary I'll arrange a discussion with John Toll.

Thanks,

Jim McKenna

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To: Fleming, Sheila[fleming.sheila@epa.gov]
From: Yamamoto, Deb
Sent: Mon 8/4/2014 5:34:38 PM
Subject: FW: LWG Comments on Revised FS Section 2
121013 notes clean.pdf

FYI.

From: Koch, Kristine
Sent: Friday, August 01, 2014 3:01 PM
To: James McKenna
Cc: Jennifer Woronets; Sheldrake, Sean; Wyatt, Robert; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Bob and Jim,

EPA is disappointed that the LWG chose to respond to my email of July 30, 2014 by further attempting to confuse the issue of background sediment concentrations for Portland Harbor. We are most concerned that the LWG continues to engage in presenting alternate interpretations of how the revised draft final RI Section 7 defined the calculated background sediment concentrations. In its July 28, 2014 email, the LWG stated that "We were simply pointing out the fact that Section 7 also includes background bedded sediment statistics based on the complete data set," and further noted in your email on July 30, 2014 that "The inclusion of more than one set of background calculations in section 7 was confirmed by the EPA and LWG senior managers in the final version of the notes from their December 10, 2013 meeting: "After considerable discussion, the EPA and LWG project managers agreed that the RI Section 7 would include four sets of background calculations, including two with the full data set and two with outliers removed."

Section 7.3 of the revised RI contains the following text:

A key element of developing appropriate background is to ensure that the data set is as free as possible of data points that are not representative of the relevant dominant background conditions.

EPA guidance (EPA 2013) notes that when present, the presence of a few high outliers can mask the normality of a data set, and that a lognormal distribution tends to accommodate outliers. Additionally, the presence of outliers tends to distort decision statistics of interest such as upper prediction limits. While the actual origin of high-biasing outliers is not always clear, EPA recommends that to provide a proper balance between false positives and false negatives, methods to calculate upper limits to describe background should only be used when the background data set represents a single environmental population without outliers.

Section 7.2.2 clearly states that "the upriver reach of the Lower Willamette River extending from RM 15.3 to 28.4 was selected as the reference area for determining background sediment concentrations."

The final version of the December 10, 2013 senior managers meeting notes clearly describes the LWG's interpretation of the "Original EPA Approach" as presenting "four sets of background calculations, including two with the full data set and two with outliers removed." However, it also clearly presents the Associate Director's final decision that "EPA is correct to depart from the Original EPA Approach because it was based on an incorrect interpretation of Guidance." The LWG chose not to dispute that finding. Thus, EPA contends the record is abundantly clear that the upriver reach was selected as representative of background sediment concentrations, and that the background sediment data set is represented only by the data collected from this reach with the obvious outlier values removed. Thus, there is only one set of background calculations presented in RI Section 7. EPA views the LWG's continued parsing of this clear record disingenuous and deeply troubling. EPA acknowledges that discussions are ongoing as to how background will be used in the FS to evaluate remedy effectiveness for those COCs for which anthropogenic background concentrations are greater than risk-based PRGs. However, we reiterate that with proper source control, background concentrations represent achievable targets resulting from long-term natural recovery, and are clearly defined solely by the statistics calculated from the upriver data set with outliers removed.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: James McKenna [mailto:jim.mckenna@verdantllc.com]
Sent: Wednesday, July 30, 2014 5:58 PM
To: Koch, Kristine
Cc: Jennifer Woronets; Sheldrake, Sean; Wyatt, Robert; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Kristine,

Thank you for your response. As you mentioned in your email the revised RI Section 7 calculates background sediment concentrations using the full data set and a data set with outliers removed. On December 12, 2013 we concluded our negotiations on the revised RI Section 7 and the LWG did not dispute EPA's modifications to this section based, in part, on the fact that various background calculations were preserved in the revised RI.

The inclusion of more than one set of background calculations in section 7 was confirmed by the EPA and LWG senior managers in the final version of the notes from their December 10, 2013 meeting: "After considerable discussion, the EPA and LWG project managers agreed that the RI Section 7 would include four sets of background calculations, including two with the full data set and two with outliers removed." This issue was further clarified by Margaret Kirkpatrick in an email to Lori Cohen dated March 26, 2014, which stated the parties agreed "(1) Section 7 of the RI includes background information both with and without "the outliers;" and (2) the LWG and EPA have not agreed upon how that information will be used in the FS. Accordingly, issues around use of the background information will be addressed in future technical discussions about the FS and any future disagreements could be elevated via the dispute process described in both the AOC and the forthcoming Revision Process for the Draft FS."

The LWG also communicated to you it's understanding that the issue of how background calculations would be used would be discussed in the context of the FS in an email from the LWG to you on December 12, 2013:

"The impact of background sediment concentrations developed in Section 7 on the Preliminary

Remedial Goals (PRGs) for the Feasibility Study may be the subject of future discussions (e.g., the Conceptual Site Model or revised Feasibility Study), but EPA agrees that it is not directing changes to the FS or the PRGs through these revisions to Section 7."

You acknowledged our concerns in a response email later that day:

"Revisions of Sections 5 and 10 of the RI will focus on comparing contaminant concentrations in the various reaches of the river. *This section* [Section 7] *is merely discussing the calculation of background concentrations, not how background will be applied. We agree that those conversations will take place in the future as the application of background is conducted (e.g., identification of areas of contamination, development of PRGs, evaluation of remedy effectiveness, etc.). PRGs are developed in the FS, so EPA is not directing the LWG to do anything with the FS regarding background at this point."* [emphasis from original email text].

The LWG and EPA are now engaged in technical discussions regarding the revised RI Section 5 and we received EPA's revised Section 10 yesterday. We are also involved in detailed technical discussions on the revised FS. However, we have yet to get into the details of where and how background will be incorporated, considered, and weighed in the revised FS. The LWG has provided you technical comments on the application of background sediment concentrations as we understood those concentrations were to be used in Section 2 of the FS. We look forward to continuing this discussion while reviewing the draft revised RI Section 10 and revised sections of the FS and can assess how background is incorporated into the various analyses.

Thanks,

Jim McKenna

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jim.mckenna@verdantllc.com

From: Koch, Kristine [mailto:Koch.Kristine@epa.gov]
Sent: Monday, July 28, 2014 1:36 PM
To: James McKenna; Wyatt, Robert
Cc: Jennifer Woronets; Sheldrake, Sean; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Bob and Jim - EPA agreed to a presentation of statistics on both the full background data set and with outliers removed in the revisions to the RI Section 7 because our guidance recommends observing whether removing outliers has a discernable effect on the calculated statistics. In this case, the outliers exerted undue influence on the statistics (one of the definitions of outliers), and EPA considers only the data set with outliers removed as descriptive of upstream bedded sediment concentrations. Those concentrations will be used in the FS as representative of concentrations achievable from upstream loading through long-term MNR with sources adequately controlled.

We are puzzled and concerned that the LWG continues to believe that the presentation of the "full" data set in Section 7 means that the outliers are in any way considered part of "background" for the Portland Harbor site. Consistent with the agreed-upon process for revisions to the draft final RI, the LWG also agreed that background concentrations for Portland Harbor are represented by the upstream data set with outliers removed when it agreed to the revised Section 7, and EPA considers this issue to be resolved.

Regards,

Kristine Koch
Remedial Project Manager
USEPA, Office of Environmental Cleanup

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From: James McKenna [mailto:jim.mckenna@verdantllc.com]
Sent: Monday, July 28, 2014 11:21 AM
To: Koch, Kristine; Wyatt, Robert
Cc: Jennifer Woronets; Sheldrake, Sean; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Kristine,

The LWG recognizes EPA identified outliers in the upstream bedded sediment data set and directed the LWG to include statistical calculations of background in Section 7 of the revised RI with those outliers removed. We were simply pointing out the fact that Section 7 also includes background bedded sediment statistics based on the complete data set (i.e., with no outliers), and with consideration of organic carbon correction (for both the full data set and with outliers removed).   The various approaches for assessing sediment background in the RI is consistent with EPA guidance. Obviously, decisions will need to be made regarding where and how this information is utilized in the revised FS.

There is a range of uncertainty with many aspects of all complex Superfund site investigations, and the evaluations of background and MNR at this site are no exception. However, we feel the uncertainties are manageable and within the range of acceptability for an FS-level of analysis. We also agree with you that the equilibrium concept is worth pursuing and look forward to discussing that topic with EPA during our upcoming FS technical discussions.

Thanks,

Jim McKenna

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From: Koch, Kristine [mailto:Koch.Kristine@epa.gov]
Sent: Monday, July 28, 2014 10:03 AM
To: Wyatt, Robert; James McKenna
Cc: Jennifer Woronets; Sheldrake, Sean; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Bob and Jim – Just to clarify, the RI Section 7 does not have a "suite of background statistics". EPA viewed the data set and determined that there were "outliers" from the background data and removed those outliers in determining the background data. We do understand the limitations of the use of this data set, but absent any other data, it is what we have to use in the FS. With regard to use of the sediment trap and surface water data collected upriver, it appears to be co-located with the "outliers" EPA identified in the bedded sediment data, so the utility of this data is also limited. We agree that there will be ongoing discussions regarding how to determine equilibrium at the site, but the indications we have from the analysis conducted thus far are that there is too much uncertainty in the long-term projections of MNR in the Study Area. Again, we will be having these discussions with you during Section 4 issue resolution since that is where this evaluation will commence.

Regards,

Kristine Koch
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From: Wyatt, Robert [mailto:rjw@nwnatural.com]
Sent: Wednesday, July 23, 2014 3:24 PM
To: Koch, Kristine; Jim McKenna (jim.mckenna@verdantllc.com)
Cc: Jennifer Woronets; Sheldrake, Sean; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: RE: LWG Comments on Revised FS Section 2

Kristine,

Thank you for your response to some of the information the LWG provided on June 19 regarding background sediment calculations. Upon review of your response it appears there is a misunderstanding of some of the LWG comments, and we are providing this initial response to clarify our intent. We are happy to meet with you to discuss these issues in more detail, and if necessary follow-up with a more detailed written response.

Upon reviewing our comments, including our stated rationale for disagreement on Attachment 1, Table 2, we can see that you interpreted our comments as indicating the upstream background data set is inadequate. That is not the case. A way to clarify this point is to replace the word "data" with "statistics" in the column title "Summary of Disagreement Rationale" on Attachment 1, Table 2. Beyond that specific clarification, our primary comment is that there are reasonable limitations for the use of the upstream bedded sediment data in the Feasibility Study (e.g., they are not a good measure of the lowest achievable concentrations within the Site, against which alternative performance will be compared). This is mainly due to the different physical conditions upstream of the Study Area as compared to those within the Study Area (e.g., higher currents, smaller depositional areas, generally coarser grain size, and lower organic carbon content).

Your response also states the LWG should have understood the RI statistics would be used in the FS. The LWG fully understands that background statistics from RI will be used in the FS, and we agreed to a suite of background statistics in the revised RI Section 7. Our comments were intended to highlight that additional upstream bedded sediment statistics should also be used in the revised FS, and that all of this information, along with upstream suspended sediment and sediment trap data, support use of an equilibrium concept as described in our Attachment 2.

It is our view that a technically sound equilibrium approach will be of great benefit in setting achievable sediment remedy goals for the Site.

Thank you,

Bob.

From: Koch, Kristine [Koch.Kristine@epa.gov]
Sent: Monday, July 21, 2014 2:53 PM
To: Wyatt, Robert; Jim McKenna (jim.mckenna@verdantllc.com)
Cc: Jennifer Woronets; Sheldrake, Sean; Cora, Lori; Cohen, Lori; Yamamoto, Deb
Subject: LWG Comments on Revised FS Section 2

Bob and Jim,

This email is to respond to some of the information you provided to EPA on June 19, 2014, regarding LWG comments on the revised FS Section 2. We have discussed this issue so you should not be surprised by this response.

The following statements were made by the LWG in the June 19 information:

Attachment 1 Table 2

PCBs – "The data used to determine background are not representative of reasonable background conditions in Portland Harbor (see Attachment 2)."

Attachment 3

"Calculate sediment background values based on statistical assessments of upstream bedded sediment data that are based on technically sound methods consistent with standard accepted statistical practices and EPA's guidance."

"9 - SEDIMENT BACKGROUND STATISTICS

EPA is using RI Section 7 sediment background values based on inappropriate statistical analyses of upstream bedded sediment data for comparison to risk-based sediment PRGs in the revised FS Section 2 and potentially other purposes for later sections of the revised FS. During the draft final RI Section 7 discussions on sediment background, the LWG provided numerous technical objections to EPA's directed changes to the calculation of upstream bedded sediment background values, including issues related to organic carbon normalization and the selection of outliers (among other issues). The LWG accepted EPA's RI directions on background solely for the purposes of completing RI Section 7. For the purposes of the revised FS, the LWG disagrees for similar reasons that the RI background statistics were calculated appropriately and therefore represent technically accurate or reasonable background values for use in the revised FS.

As noted above, EPA guidance (EPA 2005) is clear that PRGs based on background (or risk) should be achievable by the sediment remedy itself. EPA's proposed background values based on inappropriately derived upstream bedded sediment statistics are unlikely to represent achievable levels for the Site. In the near future, the LWG will present to EPA under separate cover additional information on technically appropriate methods for calculating background statistics from upstream bedded sediment data that follows standard accepted statistical practices and are consistent with EPA's guidance. In addition, per Attachment 2, the LWG urges EPA to calculate equilibrium- based values for use throughout the revised FS as more representative of likely achievable background levels for the Site."

It seems from these statements that the LWG now believes (1) the LWG failed to collect adequate data for its stated purpose of establishing background concentrations for Portland Harbor, (2) the methodology to which the LWG agreed to in Section 7 of the RI to develop background in the RI was not based on EPA guidance and accepted practices, (3) and that the background concentrations should be recalculated in the FS.

With reference to the three points above,

- It is unfortunate that the LWG believes the data they collected are inadequate to develop background concentrations for the RI/FS. EPA was of the understanding that the LWG considered the data collected to be sufficient for the purposes LWG stated in its UPRIVER AND MULTNOMAH CHANNEL SEDIMENT EVALUATION AND FIELD SAMPLING PLAN TECHNICAL APPROACH (May 21, 2007), as well as several other documents submitted to EPA by the LWG. In consultation with EPA, DEQ, and the tribes, the upriver reach of the Lower Willamette River extending from RM 15.3 to 28.4 was selected as the reference area for determining background sediment concentrations. LWG has not presented any new information learned since the data was taken that would indicate the data is insufficient.

- EPA believes the data is sufficient for purposes of calculating background, and the methodology used to determine background concentrations in the RI used accepted practices and followed EPA guidance.

- The revised FS is using the background values established in the RI, section 7. As you know, these reports are complementary to each other and the FS is building off of the data and data analysis provided RI. The purpose for determining bedded upriver sediment concentrations was that those values are considered to be representative of the concentrations of mobile sediment that are depositing in the upriver reach to be indicative of sediment concentrations that would deposit within the Study Area, uninfluenced by known or suspected sources within the Downtown reach and thus representative of concentrations in sediment resulting from disposition following successful implementation of source control measures. The LWG and EPA agreed to select specific areas where deposition was known to be occurring in this reach of the river for that purpose. The LWG's argument that EPA's RI directions on background were solely for the purposes of completing the RI Section 7 is puzzling, as the stated purpose of the RI Section 7 was to establish upriver bedded sediment background concentrations.

Regards,

Kristine Koch
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